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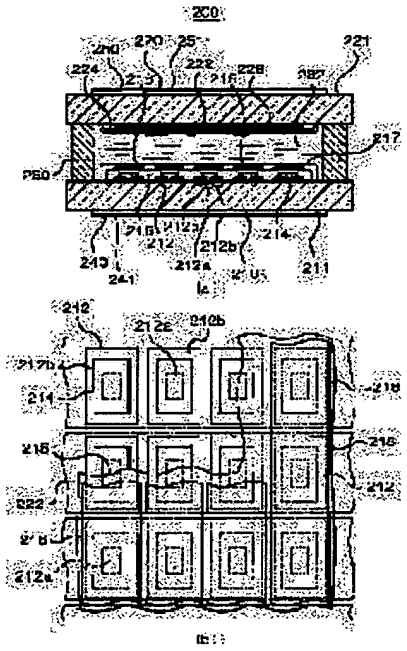
(54) ELECTRO-OPTICAL DEVICE, COLOR FILTER SUBSTRATE AND ELECTRONIC APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an electro-optical device and a color filter substrate capable of ensuring both brightness of reflective display and saturation of transmissive display when used in a display device capable of performing both reflective display and transmissive display.
SOLUTION: A reflective layer 212 having an aperture 212a for each pixel is formed on a first substrate 211, and a colored layer 214 for constituting a color filter is formed thereon. A surface protection layer 215 is formed on the colored layer 214, and a transparent 216 is formed further thereon. The colored layer 214 is constituted so as to cover the aperture 212a in a two-dimensional direction, but overlaps only a part of a reflection surface in the pixel in a two-dimensional direction.



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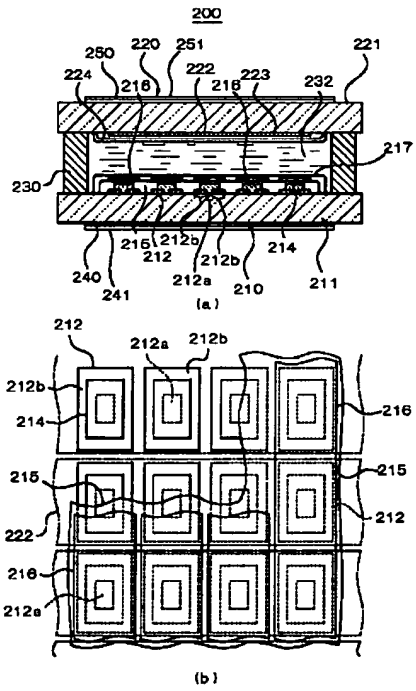
(54)【発明の名称】　電気光学装置、カラーフィルタ基板及び電子機器

(57)【要約】
【課題】　反射型表示と透過型表示の双方を可能にする表示装置に用いた場合に、反射型表示の明るさと透過型表示の彩度とを共に確保することの可能な電気光学装置及びカラーフィルタ基板を提供する。
【解決手段】　第１基板２１１上には、画素毎に開口部２１２ａを備えた反射層２１２が形成され、その上にカラーフィルタを構成する着色層２１４が形成されている。着色層２１４の上には表面保護層２１５が形成され、さらにその上に透明電極２１６が形成される。着色層２１４は開口部２１２ａを平面的に覆うように構成されているが、画素内の反射面の一部にのみ平面的に重なるように構成されている。



【特許請求の範囲】

【請求項１】　電気光学装置において、

一対の基板間に配置された電気光学物質層と、

前記一対の基板のうち一方の基板と前記電気光学物質層との間に配置された着色層と、

前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、

前記着色層は前記開口部上に配置されているとともに、前記反射部上の一部にのみ配置されていることを特徴とする電気光学装置。

【請求項２】　前記反射部の面積に対する前記着色層が配置されている前記反射部の面積の比は、前記開口部の面積に対する前記着色層が配置されている前記開口部の面積の比よりも小さいことを特徴とする請求項１に記載の電気光学装置。

【請求項３】　前記着色層は前記開口部を完全に覆うように配置されていることを特徴とする請求項１又は請求項２に記載の電気光学装置。

【請求項４】　前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることを特徴とする請求項１又は請求項２に記載の電気光学装置。

【請求項５】　電気光学装置において、

一対の表示用電極と、

前記一対の表示用電極の間に配置された電気光学物質層と、

前記一対の表示用電極の平面的な重なり領域に対応して配設された複数の画素と、

各々の前記画素内に配置された着色層と、

各々の前記画素内に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、

前記着色層は前記開口部上に配置されているとともに、前記反射部上の一部に配置されていることを特徴とする電気光学装置。

【請求項６】　前記複数の画素のそれぞれに対応する前記開口部の面積は、互いに実質的に同一であり、前記複数の画素の少なくとも一つに対応する前記着色層の面積は、その他の前記複数の画素に対応する前記着色層の面積とは異なることを特徴とする請求項５に記載の電気光学装置。

【請求項７】　電気光学装置において、

複数の画素上に配置された電気光学物質層と、

前記画素上に配置された、相互に異なる色を有する複数種類の着色層と、

各々の前記画素上に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、

前記着色層は前記開口部及び前記反射部上に配置されているとともに、前記複数種類の着色層のうちの少なくとも一種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とする電気光学装置。

【請求項８】　前記反射層の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることを特徴とする請求項７に記載の電気光学装置。

【請求項９】　前記着色層の前記反射部上の被覆面積率は、少なくとも２つの異なる色の前記着色層を備えた前記画素間で異なることを特徴とする請求項７に記載の電気光学装置。

【請求項１０】　赤、緑、青の各色の前記着色層を備え、緑の前記着色層の前記被覆面積率は赤及び青の前記着色層の前記被覆面積率よりも小さいことを特徴とする請求項９に記載の電気光学装置。

【請求項１１】　緑の前記着色層の前記被覆面積率は３０～５０％であり、赤及び青の前記着色層の前記被覆面積率は６０～１００％であることを特徴とする請求項１０に記載の電気光学装置。

【請求項１２】　前記反射部は前記開口部の全周囲に配置されていることを特徴とする請求項１、５又は７に記載の電気光学装置。

【請求項１３】　前記開口部による前記反射層に対する開口率は、３０～７０％であることを特徴とする請求項１、５又は７に記載の電気光学装置。

【請求項１４】　請求項１、５又は７に記載の電気光学装置と、該電気光学装置を制御する制御手段とを有することを特徴とする電子機器。

【請求項１５】　カラーフィルタ基板において、

基板と、

前記基板上に配置され、光を反射する反射部と開口部とを有する反射層と、

前記基板上に配置された着色層とを備え、

前記着色層は前記開口部上に配置されるとともに、前記反射部上の一部にのみ配置されていることを特徴とするカラーフィルタ基板。

【請求項１６】　カラーフィルタ基板において、

画素が設定された基板と、

前記画素に合わせて前記基板上に配置された着色層と、

前記画素に合わせて前記基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、

前記着色層は前記開口部上に配置されるとともに、前記反射部上の少なくとも一部に配置されていることを特徴とするカラーフィルタ基板。

【請求項１７】　カラーフィルタ基板において、

画素が設定された基板と、

前記画素に合わせて前記基板上に配置された、相互に異なる色を有する複数種類の着色層と、

前記画素に合わせて前記基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、

前記着色層は前記開口部及び前記反射部上に配置されるとともに、前記複数種類の着色層のうちの少なくとも一

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種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とするカラーフィルタ基板。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は電気光学装置、カラーフィルタ基板及び電子機器に係り、特に、反射層を有するカラー電気光学装置の構造として好適な技術に関する。

【０００２】

【従来の技術】従来から、外光を利用した反射型表示と、バックライト等の照明光を利用した透過型表示とのいずれをも視認可能とした反射半透過型の液晶表示パネルが知られている。この反射半透過型の液晶表示パネルは、そのパネル内に外光を反射するための反射層を有し、この反射層をバックライト等の照明光が透過できるように構成したものである。この種の反射層としては、液晶表示パネルの画素毎に所定面積の開口部（スリット）を備えたものがある。

【０００３】図２０は、従来の反射半透過型の液晶表示パネル１００の概略構造を模式的に示す概略断面図である。この液晶表示パネル１００は、基板１０１と基板１０２とがシール材１０３によって貼り合せられ、基板１０１と基板１０２との間に液晶１０４を封入した構造を備えている。

【０００４】基板１０１の内面上には、画素毎に開口部１１１ａと反射部１１１ｂとを有する反射層１１１が形成され、この反射層１１１の上に着色層１１２ｒ，１１２ｇ，１１２ｂ及び表面保護層１１２ｐを備えたカラーフィルタ１１２が形成されている。カラーフィルタ１１２の表面保護層１１２ｐの表面上には透明電極１１３が形成されている。

【０００５】一方、基板１０２の内面上には透明電極１２１が形成され、対向する基板１０１上の上記透明電極１１３と交差するように構成されている。なお、基板１０１上や基板１０２上には、配向膜や硬質透明膜などが必要に応じて適宜に形成される。

【０００６】また、上記の基板１０２の外面上には位相差板（１／４波長板）１０５及び偏光板１０６が順次配置され、基板１０１の外面上には位相差板（１／４波長板）１０７及び偏光板１０８が順次配置される。

【０００７】以上のように構成された液晶表示パネル１００は、携帯電話、携帯型情報端末などの電子機器に設置される場合、その背後にバックライト１０９が配置された状態で取付けられる。この液晶表示パネル１００においては、昼間や屋内などの明るい場所では反射経路Ｒに沿って外光が液晶１０４を透過した後に反射部１１１ｂにて反射され、再び液晶１０４を透過して放出されるので、反射型表示が視認される。一方、夜間や野外などの暗い場所ではバックライト１０９を点灯させることにより、バックライト１０９の照明光のうち開口部１１１

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ａを通過した光が透過経路Ｔに沿って液晶表示パネル１００を通過して放出されるので、透過型表示が視認される。

【０００８】

【発明が解決しようとする課題】しかしながら、上記従来の反射半透過型の液晶表示パネル１００においては、上記反射経路Ｒでは光がカラーフィルタ１１２を２回通過するのに対し、上記透過経路Ｔでは光がカラーフィルタ１１２を一度だけ通過するため、透過型表示の明度に較べて反射型表示の明度が低下し、また、反射型表示の彩度に対して透過型表示における彩度が悪くなるという問題点がある。すなわち、反射型表示では一般的に表示の明るさが不足しがちであるので、カラーフィルタ１１２の光透過率を高く設定して表示の明るさを確保する必要があるが、このようにすると、透過型表示において十分な彩度を得ることができなくなる。

【０００９】また、上記のように反射型表示と透過型表示とにおいては光がカラーフィルタを通過する回数が異なるので、反射型表示の色彩と、透過型表示の色彩とが大きく異なってしまうため、違和感を与えるという問題点もある。

【００１０】そこで本発明は上記問題点を解決するものであり、その課題は、反射型表示と透過型表示の双方を可能にする表示装置に用いた場合に、反射型表示の明るさと透過型表示の彩度とを共に確保することの可能なカラーフィルタ基板を提供することにある。また、反射型表示の明るさと透過型表示の彩度とを共に確保することの可能な反射半透過型の電気光学装置を提供することにある。さらに、反射型表示と透過型表示との間の色彩の差異を低減することのできる表示技術を実現することを目的とする。

【００１１】

【課題を解決するための手段】上記課題を解決するために本発明者は、反射層の一部にのみ着色層が平面的に重なるように構成し、反射層のその他の部分には着色層が重ならないように構成することにより、当該反射層によって反射される反射光の明るさを確保することができることを見出した。

【００１２】特に、反射半透過型の電気光学装置の場合には、光学的開口を備えた反射層を設けた上で、光学的開口には着色層が少なくとも部分的に重なるように構成する一方、反射層の一部にのみ着色層が重なるように構成することにより、反射型表示の明るさを確保しつつ透過型表示の彩度を向上させることができる。

【００１３】より具体的には、着色層を光学的開口に重ねた状態で透過型表示が良好に得られるように、予め着色層を所定の色濃度に設定しておき、その後、着色層が反射層と重なる割合を調節することによって反射型表示の明るさを確保することができる。

【００１４】本発明の電気光学装置は、一対の基板間に

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配置された電気光学物質層（例えば液晶層）と、前記一対の基板のうち一方の基板と前記電気光学物質層との間に配置された着色層と、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部上に配置されているとともに、前記反射部上の一部にのみ配置されていることを特徴とする。

【００１５】この発明によれば、着色層が開口部上に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を相互に独立して設定することが可能になる。

【００１６】ここで、前記反射層の面積に対する前記着色層と重なる前記反射部の部分の面積の比（以下、単に「反射着色比」という。）は、前記開口部の面積に対する前記着色層と重なる前記開口部の部分の面積の比（以下、単に「透過着色比」という。）よりも小さいことが好ましい。反射光は着色層を２回透過するのに対して光学的開口を通過する透過光は着色層を１回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、反射光の明るさを高めることができるとともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を低減することができる。

【００１７】また、前記着色層が前記開口部を完全に覆うように配置されていることが好ましい。着色層が光学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【００１８】ここで、前記反射層及び前記着色層は前記一対の基板のうち一方の前記基板上に配置されている場合があり、また、前記反射層は前記一対の基板のうち一方の前記基板上に配置され、前記着色層は前記一対の基板のうち他方の基板上に配置されている場合もある。いずれの場合であっても、光学的に同様の作用効果を得ることができる。

【００１９】また、前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることが好ましい。開口部上からその周囲の反射部上に張り出すように着色層が配置されていることにより、着色層を一体のものとして形成することが可能になる。したがって、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易にしかも高い歩留まりで製造することができる。

【００２０】また、本発明の別の電気光学装置は、複数の画素上に配置された電気光学物質層と、各々の前記画

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素上に配置された着色層と、各々の前記画素上に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部上に配置されているとともに、前記反射部上の一部にのみ配置されていることを特徴とする。

【００２１】本発明によれば、複数の画素において、着色層が開口部上に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを画素毎に調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を画素毎に相互に独立して設定することが可能になる。

【００２２】ここで、各々の前記画素において、前記反射部の全面積に対する前記着色層と重なる前記反射部の部分の面積の比は、前記開口部の全面積に対する前記着色層と重なる前記開口部の部分の面積の比よりも小さいことが好ましい。反射光は着色層を２回透過するのに対して光学的開口を通過する透過光は着色層を１回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、画素毎に反射光の明るさを高めることができるとともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を画素毎に低減することができる。

【００２３】また、前記着色層が前記開口部を完全に覆うように配置されていることが好ましい。着色層が光学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【００２４】さらに、前記電気光学物質層を挟持した一対の基板を備え、前記反射層及び前記着色層は前記一対の基板のうち一方の基板上に配置されている場合があり、また、前記反射層は前記一対の基板のうち一方の前記基板上に配置され、前記着色層は前記一対の基板のうち他方の前記基板上に配置されている場合もある。いずれの場合であっても、光学的に同様の作用効果を得ることができる。

【００２５】また、各々の前記画素において、前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることが好ましい。これによれば、画素毎に、開口部に平面的に重なる領域から周囲の前記反射層上に張り出した一体構造となるように着色層を設けることができるので、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易に、しかも高い歩留まりで製造することができる。

【００２６】また、本発明の異なる電気光学装置は、一

対の表示用電極と、前記一対の表示用電極の間に配置された電気光学物質層と、前記一対の表示用電極の平面的な重なり領域に対応して配設された複数の画素と、各々の前記画素内に配置された着色層と、各々の前記画素内に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部上に配置されているとともに、前記反射部上の一部に配置されていることを特徴とする。

【００２７】この場合に、前記複数の画素のそれぞれに対応する前記開口部の面積は、互いに実質的に同一であり、前記複数の画素の少なくとも一つに対応する前記着色層の面積は、その他の前記複数の画素に対応する前記着色層の面積とは異なることが好ましい。

【００２８】さらに、本発明の別の電気光学装置は、複数の画素上に配置された電気光学物質層と、前記画素上に配置された、相互に異なる色を有する複数種類の着色層と、各々の前記画素上に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部及び前記反射部上に配置されているとともに、前記複数種類の着色層のうちの少なくとも一種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とする。

【００２９】本発明において、前記反射層の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることが好ましい。反射層の開口部の面積が異なる色の着色層を備えた画素間で同一に構成されていることにより、各色の画素において入射光量を等しくすることができるため、透過表示の色調整を比較的簡単に行うことが可能になる。また、反射部の面積についても異なる色の着色層を備えた画素間で同一に構成されるので、反射表示の色調整を行う際に、各色に対する着色層の反射部上の面積を調整しやすくなる。

【００３０】本発明において、前記着色層の前記反射部上の被覆面積率（上記の反射着色比と同等）は、少なくとも２つの異なる色の前記着色層を備えた前記画素間で異なることが好ましい。これにより、開口部の透過光によって実現される透過表示の色を最適化するように各色の着色層の光学特性を調整するとともに、反射部と重なる各色の着色層の被覆面積率を調整することにより反射表示の色を最適化するといったことが可能になる。したがって、各色についてそれぞれ透過表示の色と反射表示の色とを独立に調整することができる。

【００３１】本発明において、赤、緑、青の各色の前記着色層を備え、緑の前記着色層の前記被覆面積率は赤及び青の前記着色層の前記被覆面積率よりも小さいことが好ましい。透過表示は、開口部と重なる領域において着色層を１回だけ透過した光により構成されるが、反射表示は、反射部と重なる領域において着色層を２回透過する光により主として構成され、部分的に開口部と重なる領域における着色層による反射光にも影響される。したがって、一般的に反射表示は透過表示よりも彩度が高くなる反面、暗くなりやすい。ところで、比視感度は黄緑の波長領域にピークを有するため、赤及び青の光の彩度が上がると暗くなるのに対して、緑の光の彩度を上げても暗くなりにくい。これにより、反射表示において明度を高めようとすれば、特に赤や青の彩度が低下しやすくなる。したがって、赤や青の画素においては、被覆面積率を高くして（すなわち、着色層と重ならない反射部の面積をなくすか、或いは、少なくして）彩度を確保し、緑の画素においては被覆面積率を低くする（すなわち、着色層と重ならない反射部の面積を増大させる）ことにより反射光量をかせぐようにすれば、反射表示の色再現性を確保しつつ、明度を大幅に増大させることが可能になる。

【００３２】本発明において、緑の前記着色層の前記被覆面積率は３０～５０％であり、赤及び青の前記着色層の前記被覆面積率は６０～１００％であることが好ましい。緑の被覆面積率と赤及び青の被覆面積率を上記範囲に設定することにより、透過表示の色再現性を確保しつつ、反射表示の色再現性及び明度を向上させることができる。特に、緑の着色層の被覆面積率としては３５～４５％、赤及び青の着色層の被覆面積率としては８５～１００％の範囲であることが最も望ましい。

【００３３】本発明において、前記反射部は前記開口部の全周囲に配置されていることが好ましい。これにより、反射層において開口部が反射部により取り囲まれた状態に形成されていることとなるため、着色層と反射層との間に多少の位置ずれが発生したとしても、着色層で覆われない領域が開口部に生じないようにすることができる。特に、前記開口部は前記反射層の略中央に形成されていることが望ましい。

【００３４】本発明において、前記開口部による前記反射層に対する開口率は、３０～７０％であることが好ましい。一般に、反射層の開口率が大きくなると透過表示は明るくなるが、反射表示は逆に暗くなるので、透過表示と反射表示のバランスを採るように反射層の開口率を設定する必要がある。より具体的には、開口率が小さすぎると、バックライトの照度を高くする必要があり、バックライトの消費電力が増大する。また、開口率が大きすぎると、反射表示が暗くなり視認しにくくなる。本実施形態では、反射部の一部に着色層と重ならない領域が設けられることにより反射表示の明るさをかせぐことができるので、反射層全体に着色層を重ねた構造を採用する場合に較べて、開口率が大きい上記範囲で透過表示と反射表示のバランスをとることが可能になり、透過表示と反射表示の双方において良好なカラー品位を実現することができる。開口率が上記範囲を下回ると、透過表示の明度を確保する必要から消費電力が増大するので携帯

電話等の携帯型電子機器には採用しにくくなる。また、開口率が上記範囲を上回ると、反射表示における明度と彩度の両立が困難になり、反射表示におけるカラー品位を確保することが難しくなる。

【００３５】本発明の電子機器は、上記いずれかの電気光学装置と、この電気光学装置を制御する制御手段とを有することを特徴とする。特に、電気光学装置としてのカラー表示可能な液晶表示装置を備えた電子機器、例えば、携帯電話、携帯型情報端末、液晶表示機能を有する撮像装置など、が挙げられる。これによって、電子機器の表示部として電気光学装置を用いる場合には、反射型表示と透過型表示との色彩の相違を低減し、高い表示品位を実現することができる。

【００３６】なお、反射型表示と透過型表示にはそれぞれに適した色彩の発色態様があり、それぞれに別個のカラーフィルタを設けることができるのであればよいが、実際には、共通のカラーフィルタで双方の表示を実現しなければならない。本発明においては、上記のように反射着色比と透過着色比とを相互に変えることによって、着色層が共通であっても反射型表示の着色態様と透過型表示の着色態様とを別々に設定することが可能になる。

【００３７】次に、本発明のカラーフィルタ基板は、基板と、前記基板上に配置され、光を反射する反射部と開口部とを有する反射層と、前記基板上に配置された着色層とを備え、前記着色層は前記開口部上に配置されるとともに、前記反射部上の一部にのみ配置されていることを特徴とする。

【００３８】本発明によれば、着色層が開口部上に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を相互に独立して設定することが可能になる。

【００３９】ここで、前記反射部の全面積に対する前記着色層が配置されている前記反射部の面積の比は、前記開口部の全面積に対する前記着色層が配置されている前記開口部の面積の比よりも小さいことが好ましい。反射光は着色層を２回透過するのに対して光学的開口を通過する透過光は着色層を１回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、画素毎に反射光の明るさを高めることができるともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を画素毎に低減することができる。

【００４０】また、前記着色層が前記的開口部を完全に覆うように配置されていることが好ましい。着色層が光学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【００４１】さらに、前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることが好ましい。開口部上からその周囲の反射部上に張り出すように着色層が配置されていることにより、着色層を一体のものとして形成することが可能になる。したがって、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易にしかも高い歩留まりで製造することができる。

【００４２】また、本発明の別のカラーフィルタ基板は、画素が設定された基板と、前記画素に合わせて前記基板上に配置された着色層と、前記画素に合わせて基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部上に配置されるとともに、前記反射部上の少なくとも一部に配置されていることを特徴とする。

【００４３】この発明によれば、着色層が開口部上に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを画素毎に調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を相互に独立して設定することが可能になる。

【００４４】ここで、前記反射部の全面積に対する前記着色層が配置された前記反射部の面積の比は、前記開口部の全面積に対する前記着色層が配置された前記開口部の面積の比よりも小さいことが好ましい。反射光は着色層を２回透過するのに対して光学的開口を通過する透過光は着色層を１回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、画素毎に反射光の明るさを高めることができるともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を画素毎に低減することができる。

【００４５】また、前記着色層が前記開口部を完全に覆うように配置されていることが好ましい。着色層が光学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【００４６】さらに、前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることが好ましい。開口部上からその周囲の反射部上に張り出すように着色層が配置されていることにより、着色層を一体のものとして形成することが可能になる。したがって、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易にしかも高い歩留まりで製造することができる。

【００４７】次に、本発明の別のカラーフィルタ基板は、画素が設定された基板と、前記画素に合わせて前記基板上に配置された、相互に異なる色を有する複数種類の着色層と、前記画素に合わせて前記基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部及び前記反射部上に配置されるとともに、前記複数種類の着色層のうちの少なくとも一種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とする。

【００４８】本発明において、前記反射層の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることが好ましい。反射層の開口部の面積が異なる色の着色層を備えた画素間で同一に構成されていることにより、各色の画素において入射光量を等しくすることができるため、透過表示の色調整を比較的簡単に行うことが可能になる。また、反射部の面積についても異なる色の着色層を備えた画素間で同一に構成されるので、反射表示の色調整を行う際に、各色に対する着色層の反射部上の面積を調整しやすくなる。

【００４９】また、前記着色層の前記反射部上の被覆面積率は、少なくとも２つの異なる色の前記着色層を備えた前記画素間で異なることが好ましい。これにより、開口部の透過光によって実現される透過表示の色を最適化するように各色の着色層の光学特性を調整するとともに、反射部と重なる各色の着色層の被覆面積率を調整することにより反射表示の色を最適化するといったことが可能になる。したがって、各色についてそれぞれ透過表示の色と反射表示の色とを独立に調整することができる。

【００５０】この場合に、赤、緑、青の各色の前記着色層を備え、緑の前記着色層の前記被覆面積率は赤及び青の前記着色層の前記被覆面積率よりも小さいことが望ましい。透過表示は、開口部と重なる領域において着色層を１回だけ透過した光により構成されるが、反射表示は、反射部と重なる領域において着色層を２回透過する光により主として構成され、部分的に開口部と重なる領域における着色層による反射光にも影響される。したがって、一般的に反射表示は透過表示よりも彩度が高くなる反面、暗くなりやすい。ところで、比視感度は黄緑の波長領域にピークを有するため、赤及び青の光の彩度が上がると暗くなるのに対して、緑の光の彩度を上げても暗くなりにくい。これにより、反射表示において明度を高めようとすれば、特に赤や青の彩度が低下しやすくなる。したがって、赤や青の画素においては、被覆面積率を高くして（すなわち、着色層と重ならない反射部の面積をなくすか、或いは、少なくして）彩度を確保し、緑の画素においては被覆面積率を低くする（すなわち、着色層と重ならない反射部の面積を増大させる）ことにより反射光量をかせぐようにすれば、反射表示の色再現性を確保しつつ、明度を大幅に増大させることが可能になる。

【００５１】さらに、緑の前記着色層の前記被覆面積率は３０～５０％であり、赤及び青の前記着色層の前記被覆面積率は６０～１００％であることが好ましい。緑の被覆面積率と赤及び青の被覆面積率を上記範囲に設定することにより、透過表示の色再現性を確保しつつ、反射表示の色再現性及び明度を向上させることができる。特に、緑の着色層の被覆面積率としては３５～４５％、赤及び青の着色層の被覆面積率としては８５～１００％の範囲であることが最も望ましい。

【００５２】また、前記反射部は前記開口部の全周囲に配置されていることが好ましい。これにより、反射層において開口部が反射部により取り囲まれた状態に形成されていることとなるため、着色層と反射層との間に多少の位置ずれが発生したとしても、着色層で覆われない領域が開口部に生じないようにすることができる。特に、前記開口部は前記反射層の略中央に形成されていることが望ましい。

【００５３】さらに、前記開口部による前記反射層に対する開口率は、３０～７０％であることが好ましい。一般に、反射層の開口率が大きくなると透過表示は明るくなるが、反射表示は逆に暗くなるので、透過表示と反射表示のバランスを採るように反射層の開口率を設定する必要がある。より具体的には、開口率が小さすぎると、バックライトの照度を高くする必要があり、バックライトの消費電力が増大する。また、開口率が大きすぎると、反射表示が暗くなり視認しにくくなる。本実施形態では、反射部の一部に着色層と重ならない領域が設けられることにより反射表示の明るさをかせぐことができるので、反射層全体に着色層を重ねた構造を採用する場合や、反射部に重なる部分と開口部に重なる部分とで異なる光学特性の着色層を構成する場合などに較べて、開口率が大きい上記範囲で透過表示と反射表示のバランスをとることが可能になり、透過表示と反射表示の双方において良好なカラー品位を実現することができる。開口率が上記範囲を下回ると、透過表示の明度を確保する必要から消費電力が増大するので携帯電話等の携帯型電子機器には採用しにくくなる。また、開口率が上記範囲を上回ると、反射表示における明度と彩度の両立が困難になり、反射表示におけるカラー品位を確保することが難しくなる。

【００５４】

【発明の実施の形態】次に、添付図面を参照して本発明に係る電気光学装置、カラーフィルタ基板及び電子機器の実施形態について詳細に説明する。

【００５５】［第１実施形態］図１は、本発明に係る第１実施形態の電気光学装置を構成する液晶パネル２００の外観を示す概略斜視図であり、図２（ａ）は、液晶パネル２００の模式的な概略断面図、図２（ｂ）は、液晶パネル２００を構成するカラーフィルタ基板２１０の拡

大部分平面図である。

【００５６】この電気光学装置は、いわゆる反射半透過方式のパッシブマトリクス型構造を有する液晶パネル２００に対して、必要に応じて図示しないバックライトやフロントライト等の照明装置やケース体などを適宜に取付けてなる。

【００５７】図１に示すように、液晶パネル２００は、ガラス板や合成樹脂板等からなる透明な第１基板２１１を基体とするカラーフィルタ基板２１０と、これに対向する同様の第２基板２２１を基体とする対向基板２２０とがシール材２３０を介して貼り合わせられ、シール材２３０の内側に注入口２３０ａから液晶２３２が注入された後、封止材２３１にて封止されてなるセル構造を備えている。

【００５８】第１基板２１１の内面（第２基板２２１に対向する表面）上には複数並列したストライプ状の透明電極２１６が形成され、第２基板２２１の内面上には複数並列したストライプ状の透明電極２２２が形成されている。また、上記透明電極２１６は配線２１８Ａに導電接続され、上記透明電極２２２は配線２２８に導電接続されている。透明電極２１６と透明電極２２２とは相互に直交し、その交差領域はマトリクス状に配列された多数の画素を構成し、これらの画素配列が液晶表示領域Ａを構成している。

【００５９】第１基板２１１は第２基板２２１の外形よりも外側に張り出してなる基板張出部２１０Ｔを有し、この基板張出部２１０Ｔ上には、上記配線２１８Ａ、上記配線２２８に対してシール材２３０の一部で構成される上下導通部を介して導電接続された配線２１８Ｂ、及び、独立して形成された複数の配線パターンからなる入力端子部２１９が形成されている。また、基板張出部２１０Ｔ上には、これら配線２１８Ａ，２１８Ｂ及び入力端子部２１９に対して導電接続されるように、液晶駆動回路等を内蔵した半導体ＩＣ２６１が実装されている。また、基板張出部２１０Ｔの端部には、上記入力端子部２１９に導電接続されるように、フレキシブル配線基板２６３が実装されている。

【００６０】この液晶パネル２００において、図２に示すように、第１基板２１１の外面には位相差板（１／４波長板）２４０及び偏光板２４１が配置され、第２基板２２１の外面には位相差板（１／４波長板）２５０及び偏光板２５１が配置されている。

【００６１】＜カラーフィルタ基板２１０の構造＞次に、図２（ａ）及び（ｂ）を参照して、カラーフィルタ基板２１０の構造を詳細に説明する。第１基板２１１の表面には反射層２１２が形成され、上記画素毎に開口部２１２ａが設けられている。この反射層２１２のうち、開口部２１２ａ以外の部分が実質的に光を反射する反射部２１２ｂである。本実施形態の場合には画素毎に開口部２１２ａと反射部２１２ｂとを有する反射層２１２が形成されている。もっとも、反射層２１２を液晶表示領域Ａ全体に形成し、開口部２１２ａのみを画素毎に形成してもよい。

【００６２】反射層２１２の上には着色層２１４が形成され、その上を透明樹脂等からなる表面保護層（オーバーコート層）２１５が被覆している。この着色層２１４と表面保護層２１５とによってカラーフィルタが形成される。

【００６３】着色層２１４は、通常、透明樹脂中に顔料や染料等の着色材を分散させて所定の色調を呈するものとされている。着色層の色調の一例としては原色系フィルタとしてＲ（赤）、Ｇ（緑）、Ｂ（青）の３色の組合せからなるものがあるが、これに限定されるものではなく、補色系その他の種々の色調で形成できる。通常、基板表面上に顔料や染料等の着色材を含む感光性樹脂からなる着色レジストを塗布し、フォトリソグラフィ法によって不要部分を除去することによって、所定のカラーパターンを有する着色層を形成する。ここで、複数の色調の着色層を形成する場合には上記工程を繰り返す。

【００６４】なお、着色層の配列パターンとして、図２（ｂ）に示す図示例ではストライプ配列を採用しているが、このストライプ配列の他に、デルタ配列や斜めモザイク配列等の種々のパターン形状を採用することができる。また、上記ＲＧＢの各着色層の周囲には、着色層の一部として、画素間領域の遮光を行うための遮光膜（ブラックマトリクス或いはブラックマスク）を形成することができる。

【００６５】表面保護層２１５の上には、ＩＴＯ（インジウムスズ酸化物）等の透明導電体からなる透明電極２１６が形成されている。透明電極２１６は図２（ｂ）の図示上下方向に伸びる帯状に形成され、複数の透明電極２１６が相互に並列してストライプ状に構成されている。透明電極２１６の上にはポリイミド樹脂等からなる配向膜２１７が形成されている。

【００６６】本実施形態においては、図２（ｂ）に示すように、カラーフィルタを構成する着色層２１４が、各画素内において反射層２１２の開口部２１２ａを完全に覆うように平面的に重なっているとともに、開口部２１２ａと平面的に重なる領域から周囲へ向けて、開口部２１２ａの周囲の反射部２１２ｂ上に張り出すように一体に形成されている。

【００６７】また、着色層２１４は、各画素全体に形成されているのではなく、反射層２１２の一部にのみ重なるように形成されている。すなわち、反射層２１２には、着色層２１４と平面的に重なる領域（図示例では開口部２１２ａに臨む内周領域）と、着色層２１４と平面的に重ならない領域（図示例では外周領域）とが存在する。

【００６８】一方、上記液晶パネル２００において、上記カラーフィルタ基板２１０と対向する対向基板２２０

は、ガラス等からなる第２基板２２１上に、上記と同様の透明電極２２２、SiO_2やTiO_2などからなる硬質保護膜２２３、上記と同様の配向膜２２４を順次積層させたものである。

【００６９】以上のように構成された本実施形態において、対向基板２２０側から反射部２１２ｂに入射した外光は一部が着色層２１４を透過した後に反射部２１２ｂにて反射し、一部が着色層２１４を通過することなく反射部２１２ｂにて反射し、再び対向基板２２０を透過して出射する。このとき、着色層２１４を透過する外光は着色層２１４を２回通過するが、着色層２１４を透過しない外光は着色層２１４を通過することなく出射する。したがって、着色層２１４が画素内の反射層２１２全体を覆っている場合に較べて反射型表示の明度を向上させることができる。

【００７０】一方、着色層２１４は反射層２１２の開口部２１２ａを全て覆っているので、例えばカラーフィルタ基板２１０の背後にバックライト等を配置して、背後から照明光を照射した場合には、当該照明光の一部が開口部２１２ａを通過して着色層２１４を透過し、液晶２３２及び対向基板２２０を通過して出射する。したがって、透過光は着色層２１４を１回だけ透過するため、着色層２１４の色濃度（光を透過させた場合に可視光領域のスペクトル分布に偏りを与える度合）に応じた透過型表示の色彩が得られる。このとき、反射光の彩度は上記のように着色層を通過しない反射光成分が含まれているために低下するので、透過型表示の彩度は相対的に高まる。

【００７１】本実施形態では、着色層２１４の光学的特性を透過型表示に対応するように形成し、着色層２１４と平面的に重なる反射部２１２ｂの反射面積を調整することにより、反射型表示の色彩、特に明度、を確保することができる。したがって、反射型表示の明るさを確保しながら透過型表示の彩度を高めることができる。また、反射型表示と透過型表示との色彩（特に彩度と明度）の差異を低減することもできる。

【００７２】上記の効果は、通常のカラーフィルタの製造工程と同様に、着色層を全体的にほぼ一様の色濃度に（例えば顔料や染料等の着色材の濃度をほぼ一様に）形成するとともに、着色層を全体的にほぼ一様の厚さに形成する場合には特に好適である。この場合には、着色層２１４における開口部２１２ａに平面的に重なる領域と、着色層２１４における反射部２１２ｂに平面的に重なる領域との光学的特性がほぼ一致するので、従来構造では反射型表示の色彩と透過型表示の色彩との間に必然的に大きな彩度や明度の相違が生ずるから、本発明の効果が特に顕著なものとなる。

【００７３】反射型表示と透過型表示にはそれぞれに適した色彩の発色態様があり、それぞれに別個のカラーフィルタを設けることができるのであればよいが、実際には、共通のカラーフィルタで双方の表示を実現することが製造上好ましい。本実施形態では、上記のように反射着色比と透過着色比とを相互に変えることによって、着色層が共通であっても反射型表示の着色態様と透過型表示の着色態様とを別々に設定することが可能になった。

【００７４】［第２実施形態］次に、図３（ａ）及び（ｂ）を参照して本発明に係る第２実施形態について説明する。この実施形態の液晶パネル３００では、上記第１実施形態と同様の第１基板３１１、第２基板３２１、着色層３１４、表面保護層３１５、透明電極３１６、配向膜３１７、透明電極３２２、硬質保護膜３２３、配向膜３２４、シール材３３０、液晶３３２、位相差板３４０，３５０、偏光板３４１，３５１を有しているので、これらについては説明を省略する。

【００７５】本実施形態の液晶パネル３００においては、反射層３１２が液晶表示領域内にほぼ全面的に一体に形成されており、画素毎に開口部３１２ａが設けられている。この反射層３１２のうち、開口部３１２ａ以外の部分が実質的に光を反射する反射部３１２ｂである。また、画素間領域には黒色樹脂等からなる黒色遮光膜３１４ＢＭが形成されている。黒色樹脂としては、黒色の顔料や染料等の着色材を透明樹脂中に分散させたもの、或いは、Ｒ（赤）、Ｇ（緑）及びＢ（青）の３色の着色材を共に混合させて透明樹脂中に分散させたものなどが用いられる。

【００７６】本実施形態では反射層３１２を複数の画素に亘って一体に形成されたものとしたが、第１実施形態のように画素毎に反射層を形成し、反射層の間に上記黒色遮光膜を形成してもよい。

【００７７】［第３実施形態］次に、図４（ａ）及び（ｂ）を参照して本発明に係る第３実施形態について説明する。この実施形態の液晶パネル４００は、上記第２実施形態と同様の第１基板４１１、第２基板４２１、開口部４１２ａと反射部４１２ｂとを有する反射層４１２、透明電極４１６、配向膜４１７、透明電極４２２、配向膜４２３、シール材４３０、液晶４３２、位相差板４４０，４５０、偏光板４４１，４５１を有しているので、これらについては説明を省略する。

【００７８】本実施形態においては、図４（ａ）に示すように、反射層４１２の形成された第１基板４２１ではなく、第２基板４２１上にカラーフィルタが形成されている。より具体的には、第２基板４２１上には着色層４２４が画素毎に形成され、画素間領域には第２実施形態と同様の黒色遮光膜４２４ＢＭが形成されている。着色層４２４及び黒色遮光膜４２４ＢＭの上には透明な表面保護層４２５が形成されている。

【００７９】上記表面保護層４２５上には透明電極４２２が形成され、この透明電極４２２の上には配向膜４２３が形成されている。

【００８０】図４（ｂ）に示すように、反射層４１２の

形成された反射基板４１０に対して、カラーフィルタ基板４２０の着色層４２４（図示一点鎖線）は、反射層４１２の開口部４１２ａと平面的に重なり、開口部４１２ａを完全に覆うように構成されている。また、着色層４２４は開口部４１２ａと平面的に重なる領域から周囲に向けて反射層４１２の反射部４１２ｂと重なる領域に張り出すように一体に構成されている。すなわち、反射層４１２は、着色層４２４と平面的に重なる領域（図示例では内周領域）と、着色層４２４と平面的に重ならない領域（図示例では外周領域）とを備えている。

【００８１】本実施形態のように反射層４１２と着色層４２４とが異なる基板上に形成されていても、反射層４１２と着色層４２４の平面的な重なり態様が上記のように構成されていれば、第１実施形態及び第２実施形態と同様の作用効果を奏することができる。

【００８２】［その他の構成例］次に、図５（ａ）～（ｄ）及び図６（ａ）～（ｄ）を参照して、上記各実施形態に適用可能なその他の構成例について説明する。以下に説明する各構成例では、反射層と着色層との平面的な位置関係についてのみ図示し、説明する。

【００８３】（構成例１）　図５（ａ）に示す構成例１においては、各画素において、開口５１２ａを備えた反射層５１２上に、Ｒ（赤）の色相を呈する着色層５１４ｒと、Ｇ（緑）の色相を呈する着色層５１４ｇと、Ｂ（青）の色相を呈する着色層５１４ｂとがそれぞれ平面的に重なるように形成されている。この構成例では、上記各実施形態と同様に、各画素内の着色層５１４ｒ，５１４ｇ，５１４ｂがそれぞれ開口部５１２ａを完全に覆うように構成され、開口部５１２ａと平面的に重なる領域から周囲の反射面と平面的に重なる領域に張り出すように、一体に構成されている。

【００８４】（構成例２）　図５（ｂ）に示す構成例２においては、各画素において、開口部６１２ａを備えた反射層６１２上に、Ｒ（赤）の色相を呈する着色層６１４ｒと、Ｇ（緑）の色相を呈する着色層６１４ｇと、Ｂ（青）の色相を呈する着色層６１４ｂとがそれぞれ平面的に重なるように形成されている。この構成例では、各着色層６１４ｒ，６１４ｇ，６１４ｂが開口部６１２ａを完全に覆ってはおらず、開口部６１２ａの一部に着色層と平面的に重ならない領域が存在する。

【００８５】この構成例２では、反射型表示と透過型表示との色彩の差異を低減させるために、反射着色比（反射層６１２の全反射面積に対する着色層と平面的に重なる領域の面積比）が透過着色比（開口部６１２ａの全開口面積に対する着色層と平面的に重なる領域の面積比）よりも小さくなるように構成されている。この結果、反射表示の明度は向上し、透過型表示の彩度は相対的に高まる。

【００８６】（構成例３）　図５（ｃ）に示す構成例３においては、各画素において、開口部７１２ａを備えた反射層７１２上にそれぞれ平面的に重なるように、それぞれ複数の、Ｒ（赤）の色相を呈する着色層７１４ｒ，７１５ｒ，７１６ｒと、Ｇ（緑）の色相を呈する着色層７１４ｇ，７１５ｇ，７１６ｇと、Ｂ（青）の色相を呈する着色層７１４ｂ，７１５ｂ，７１６ｂとが形成されている。

【００８７】この構成例では、着色層７１４ｒ，７１４ｇ，７１４ｂが開口部７１２ａと平面的に重なり、それ以外の着色層７１５ｒ，７１５ｇ，７１５ｂ，７１６ｒ，７１６ｇ，７１６ｂが反射層７１２の反射面上にのみ平面的に重なるように構成されている。このように各画素においてそれぞれ複数の着色層が平面的に重なるように構成されていても構わない。

【００８８】（構成例４）　図５（ｄ）に示す構成例４においては、開口部８１２ａを備えた反射層８１２上に、Ｒ（赤）の色相を呈する着色層８１４ｒと、Ｇ（緑）の色相を呈する着色層８１４ｇと、Ｂ（青）の色相を呈する着色層８１４ｂとがそれぞれ平面的に重なるように形成されている。この構成例では、着色層８１２ｒ，８１２ｇ，８１２ｂが相互に異なった面積になるように構成され、その結果、反射着色比（画素内の全反射面積に対する着色層と平面的に重なった反射面積の比）が、着色層の色相Ｒ（赤）、Ｇ（緑）及びＢ（青）に応じて相互に異なった値になっている。より一般的に言えば、上記反射着色比と、透過着色比（画素内の全開口面積に対する着色層と平面的に重なった開口面積の比）との比が色毎に相互に異なった値となっている。

【００８９】本構成例４によれば、上記実施形態や他の構成例のように反射型表示と透過型表示の色彩を別々に設定できるだけでなく、上記反射着色比（或いは反射着色比と透過着色比との比）を色毎に設定することにより、各色の着色層の材質に応じて適切な色彩を得ることができる。

【００９０】（構成例５）　図６（ａ）に示す構成例５においては、反射層９１２において画素毎に複数（図示例では２つ）の開口部９１２ａが設けられている。この反射層９１２のうち、開口部９１２ａ以外の部分が実質的に光を反射する反射部９１２ｂである。そして、この反射層９１２と平面的に重なる着色層９１４ｒ，９１４ｇ，９１４ｂは、それぞれ複数の開口部９１２ａを覆うとともに、反射部９１２ｂの一部のみに平面的に重なるように構成されている。

【００９１】（構成例６）　図６（ｂ）に示す構成例６においては、開口部１０１２ａと反射部１０１２ｂとを有する反射層１０１２と平面的に重なる複数（図示例では３つ）の着色層１０１４ｒ，１０１４ｇ，１０１４ｂ，１０１５ｒ，１０１５ｇ，１０１５ｂ，１０１６ｒ，１０１６ｇ，１０１６ｂが設けられている。ここで、着色層１０１４ｒ，１０１４ｇ，１０１４ｂは開口部１０１２ａと平面的に重なるように構成され、着色層

１０１５ｒ，１０１５ｇ，１０１５ｂ，１０１６ｒ，１０１６ｇ，１０１６ｂは反射部の一部にのみ平面的に重なるように構成されている。そして、着色層１０１４ｒ，１０１４ｇ，１０１４ｂは着色層１０１５ｒ，１０１５ｇ，１０１５ｂ，１０１６ｒ，１０１６ｇ，１０１６ｂよりも高い色濃度を有するように、すなわち、顔料や染料等の着色材をより高濃度に含むように、構成されている。

【００９２】この構成例６では、開口部１０１２ａと平面的に重なる着色層１０１４ｒ，１０１４ｇ，１０１４ｂの光濃度が高く、反射部１０１２ｂの一部にのみ平面的に重なるように構成された着色層１０１５ｒ，１０１５ｇ，１０１５ｂ，１０１６ｒ，１０１６ｇ，１０１６ｂの光濃度が低いので、上記各実施形態の場合に較べて、透過光の彩度は相対的にさらに高くなり、反射光はさらに明るくなる。

【００９３】以上のように、本発明においては、着色層の光濃度が部分的に異なるように構成する場合を排除しない。特に、着色層については、反射層の光学的開口と平面的に重なる領域の光濃度を高く、それ以外の反射層と平面的に重なる領域の光濃度を低くすることが望ましい。

【００９４】（構成例７）　図６（ｃ）に示す構成例７においては、開口部１１１２ａと反射部１１１２ｂとを有する反射層１１１２と平面的に重なる複数（図示例では２つ）の着色層１１１４ｒ，１１１４ｇ，１１１４ｂ，１１１５ｒ，１１１５ｇ，１１１５ｂが設けられている。着色層１１１４ｒ，１１１４ｇ，１１１４ｂと着色層１１１５ｒ，１１１５ｇ，１１１５ｂとは相互に積層配置されているか、或いは、相互に平面的に重なるように別々に配置されている。なお、図６（ｄ）は、この構成例７において、反射層１１１２、着色層１１１４ｒ，１１１４ｇ，１１１４ｂ及び着色層１１１５ｒ，１１１５ｇ，１１１５ｂを相互に積層して形成させた場合の断面図を示すものである。

【００９５】この構成例７においては、着色層１１１４ｒ，１１１４ｇ，１１１４ｂと着色層１１１５ｒ，１１１５ｇ，１１１５ｂとが平面的に重なる領域、すなわち、開口部１１１２ａと平面的に重なる領域においては、着色層の厚さが実質的に厚く、着色層１１１４ｒ，１１１４ｇ，１１１４ｂが形成されている領域内であって着色層１１１５ｒ，１１１５ｇ，１１１５ｂと平面的に重ならない領域、すなわち反射部１１１２ｂと平面的に重なる領域においては、着色層の厚さが実質的に薄くなるように構成されている。したがって、透過光の彩度は厚い着色層によってさらに向上し、反射光の明度は薄い着色層が部分的に形成されていることによりさらに向上する。

【００９６】以上のように、本発明においては、着色層が部分的に厚さを変えて形成されている場合を排除するものではない。特に、着色層については、反射層の光学的開口と平面的に重なる領域において実質的に厚く、それ以外の反射層と平面的に重なる領域において実質的に薄く形成することが望ましい。

【００９７】ここで、上記効果をより高めるために、開口部１１１２ａと平面的に重なる着色層１１１５ｒ，１１１５ｇ，１１１５ｂの色濃度を高く、開口部１０１２ａと平面的に重なる領域から反射面の一部に平面的に重なる領域に張り出すように構成された着色層１１１４ｒ，１１１４ｇ，１１１４ｂの色濃度を低くしてもよい。

【００９８】（構成例８）　図７には構成例８の構成を模式的に示す。この構成例８では、Ｒ画素及びＢ画素においては反射層１２１２上に全面的に着色層１２１４ｒ，１２１４ｂが形成されているが、Ｇ画素においては反射層１２１２の一部にのみ重なるように着色層１２１４ｇが形成されている。着色層１２１４ｇは、開口部１２１２ａを全面的に覆うとともに、その開口縁に張り出すように広がり、これによって着色層１２１４ｇは反射部１２１２ｂの一部にのみ重なるように構成される。

【００９９】この構成例８においては、反射層１２１２の開口率（反射層１２１２の全面積に対する開口部１２１２ａの面積の比）は、ＲＧＢ各画素に共通で３０～７０％である。また、Ｇ画素の被覆面積率（反射部１２１２ｂの面積に対する着色層１２１４ｇの面積の比）は４０～８０％である。

【０１００】上記のように構成することにより、Ｒ画素及びＢ画素においては反射部１２１２ｂに対する着色層１２１４ｒ，１２１４ｂの被覆面積率（反射部１２１２の面積に対する反射部１２１２に重なる着色層の面積の比、すなわち反射着色比）を１００％とすることで彩度を確保し、また、Ｇ画素においては反射部１２１２ｂに対する着色層１２１４ｇの被覆面積率を低くすることによって明度を高めるようにしている。このようにすると、Ｒ及びＢの彩度を実質的にあまり低下させることなく、反射表示の明るさを高めることが可能になる。

【０１０１】（構成例９）　図８には、構成例９の構成を模式的に示す。この構成例９においては、Ｂ画素では反射層１３１２上を全面的に着色層１３１４ｂが被覆し（被覆面積率１００％）、Ｒ画素では着色層１３１４ｒが反射層１３１２の一部を露出する開口部１３１４ｒａを備えている。さらに、Ｇ画素では着色層１３１４ｇが反射層１３１２の開口部１３１２ａと完全に重なるとともに、その周囲に張り出すように構成されて反射部１３１２ｂ上の一部にのみ重なっている。

【０１０２】また、この構成例９においては、反射層１３１２の開口率は、ＲＧＢ各画素に共通で３０～７０％である。また、Ｒ画素の被覆面積率は６０～１００％、Ｇ画素の被覆面積率は４０～８０％である。

【０１０３】（構成例１０）　図９には、構成例１０の

構成を模式的に示す。この構成例１０においては、Ｂ画素では反射層１４１２上を全面的に着色層１４１４ｂが被覆し（被覆面積率１００％）、Ｒ画素では着色層１４１４ｒが反射層１４１２の一部を露出する開口部１４１４ｒａを備えている。この例では開口部１４１４ｒａは２つ設けられている。さらに、Ｇ画素では着色層１４１４ｇが反射層１４１２の開口部１４１２ａと完全に重なるとともに、その周囲に張り出すように構成されて反射部１４１２ｂ上の一部にのみ重なっている。

【０１０４】また、この構成例１０においては、反射層１４１２の開口率は、ＲＧＢ各画素に共通で３０～７０％である。また、Ｒ画素の被覆面積率は６０～１００％、Ｇ画素の被覆面積率は４０～８０％である。

【０１０５】（構成例１１）　図１０には、構成例１１の構成を模式的に示す。この構成例１１においては、Ｂ画素では着色層１５１４ｂが反射層１５１２の一部を露出する開口部１５１４ｂａを備えている。この例では開口部１５１４ｂａは２つ設けられている。また、Ｒ画素では着色層１５１４ｒが反射層１５１２の一部を露出する開口部１５１４ｒａを備えている。この例では開口部１５１４ｒａは２つ設けられている。さらに、Ｇ画素では着色層１５１４ｇが反射層１５１２の開口部１５１２ａと完全に重なるとともに、その周囲に張り出すように構成されて反射部１５１２ｂ上の一部にのみ重なっている。

【０１０６】また、この構成例１１においては、反射層１５１２の開口率は、ＲＧＢ各画素に共通で３０～７０％である。また、Ｂ画素の被覆面積率は７０～１００％、Ｒ画素の被覆面積率は６０～１００％、Ｇ画素の被覆面積率は４０～８０％である。

【０１０７】（構成例１２）　図１１には、構成例１２の構成を模式的に示す。この構成例１２においては、Ｂ画素では着色層１６１４ｂが反射層１６１２の一部を露出する開口部１６１４ｂａを備えている。この例では開口部１６１４ｂａは２つ設けられている。また、Ｒ画素では着色層１６１４ｒが反射層１６１２の一部を露出する開口部１６１４ｒａを備えている。この例では開口部１６１４ｒａは２つ設けられている。さらに、Ｇ画素では着色層１６１４ｇが反射層１６１２の開口部１６１２ａと完全に重なるとともに、その周囲に張り出すように構成されて反射部１６１２ｂ上の一部にのみ重なっている。

【０１０８】また、この構成例１２においては、反射層１６１２の開口率は、ＲＧＢ各画素に共通で３０％である。また、Ｂ画素の被覆面積率は６５．３％、Ｒ画素の被覆面積率は６５．３％、Ｇ画素の被覆面積率は３０．２％である。

【０１０９】（構成例１３）　図１２には、構成例１３の構成を模式的に示す。この構成例１３においては、Ｂ画素では着色層１７１４ｂが反射層１７１２の一部を露出する開口部１７１４ｂａを備えている。この例では開口部１７１４ｂａは２つ設けられている。また、Ｒ画素では着色層１７１４ｒが反射層１７１２の一部を露出する開口部１７１４ｒａを備えている。この例では開口部１７１４ｒａは２つ設けられている。さらに、Ｇ画素では着色層１７１４ｇが反射層１７１２の開口部１７１２ａと完全に重なるとともに、その周囲に張り出すように構成されて反射部１７１２ｂ上の一部にのみ重なっている。

【０１１０】また、この構成例１３においては、反射層１７１２の開口率は、ＲＧＢ各画素に共通で３０％である。また、Ｂ画素の被覆面積率は７５．４％、Ｒ画素の被覆面積率は７５．４％、Ｇ画素の被覆面積率は４０．２％である。

【０１１１】（構成例１４）　図１３には、構成例１４の構成を模式的に示す。この構成例１４においては、Ｂ画素では着色層１８１４ｂが反射層１８１２の一部を露出する開口部１８１４ｂａを備えている。この例では開口部１８１４ｂａは２つ設けられている。また、Ｒ画素では着色層１８１４ｒが反射層１８１２の一部を露出する開口部１８１４ｒａを備えている。この例では開口部１８１４ｒａは２つ設けられている。さらに、Ｇ画素では着色層１８１４ｇが反射層１８１２の開口部１８１２ａと完全に重なるとともに、その周囲に張り出すように構成されて反射部１８１２ｂ上の一部にのみ重なっている。

【０１１２】また、この構成例１４においては、反射層１８１２の開口率は、ＲＧＢ各画素に共通で５０％である。また、Ｂ画素の被覆面積率は７５．４％、Ｒ画素の被覆面積率は７５．４％、Ｇ画素の被覆面積率は４７．７％である。

【０１１３】（構成例１５）　図１４には、構成例１５の構成を模式的に示す。この構成例１５においては、各画素の反射層１９１２は、左右一対の反射部１９１２ｂが分離された状態で設けられ、その間に開口部１９１２ａが形成される。また、Ｂ画素及びＲ画素では着色層１９１４ｂ，１９１４ｒが反射層１９１２を全面的に被覆している。さらに、Ｇ画素では着色層１９１４ｇが反射層１９１２の開口部１９１２ａと完全に重なるとともに、その周囲に張り出すように構成されて反射部１９１２ｂ上の一部にのみ重なっている。すなわち、反射部１９１２ｂは、着色層１９１４ｇに設けられた開口部１９１４ｇａにより部分的に露出した状態となっている。

【０１１４】また、この構成例１５においては、反射層１９１２の開口率は、ＲＧＢ各画素に共通で７０％である。また、Ｂ画素及びＲ画素の被覆面積率は１００％、Ｇ画素の被覆面積率は５０．０％である。

【０１１５】（光学特性）　次に、上記の構成例８乃至構成例１１の光学特性を図１５に示す。図１５は、１９３１ＣＩＥのｘｙｚ表色系におけるｘｙ色度図上におい

て、上記各構成例のＲＧＢ画素の透過光及び反射光の色データを示すものである。一般に、ｘｙ色度図においては、図１６に示すように、可視光領域の単波長光の色味（色相及び彩度）を境界線とする釣鐘形状の範囲内に現実に視認される色味が配置されるようになっている。また、３色（例えばＲＧＢ）の着色層を用いてカラー表示を行う場合には、各着色層ＲＧＢのデータ点を結ぶことによって形成される３角形内の色味を形成することが可能である。基本的には上記３角形の面積が大きい程カラー表示の品位が向上することになる。

【０１１６】図１５には、上記構成例８～１１の透過表示の色データ（図示一点鎖線で囲まれたデータ点）と、反射表示の色データ（図示二点鎖線で囲まれたデータ点）とを併記してある。ここで、菱形は構成例８のデータ点を、正方形は構成例９のデータ点を、三角形は構成例１０のデータ点を、×印は構成例１１のデータ点を示す。また、図示Ｈは白色表示のデータ点を示す。

【０１１７】図１５においては、上記構成例の色データと比較するために、反射層の開口率を３０％とし、ＲＧＢ各色に対してそれぞれ開口部に重なる透過部着色層と、反射部に重なる反射部着色層とを別々に形成し、６回のパターニングを行う６段プロセスにて形成したカラーフィルタ基板を用いた場合についても測定し、比較例として図示黒点で示してある。ここで、図１７（ａ）には上記透過部着色層の分光透過率を示し、図１７（ｂ）には上記反射部着色層の分光透過率を示す。透過領域（開口部）では光は１回のみ透過部着色層を透過するのに対して、反射領域（反射部）では光は往復するために２回反射部着色層を透過するため、透過部着色層は図１７（ａ）に示すように比較的彩度の高い光学特性を示す（平均透過率Ｔは低い）ものを採用し、反射部着色層は図１７（ｂ）に示すように比較的彩度が低いが平均透過率Ｔは高い光学特性を示すものを採用している。これにより、透過表示の彩度を確保しつつ、反射表示の明るさを向上できる。

【０１１８】本発明に係る構成例８～１１においては、上記６段プロセスの比較例の透過部着色層と同一の光学特性、すなわち図１７（ａ）に示す分光透過率を呈する着色層を用いた。その結果、図１５に示すように、上記比較例に近い反射表示のカラー品位を得ることができた。特に、構成例１１は、上記比較例と実質的にほぼ等しい色相及び彩度を有する構成となっている。このように、本発明においては、透過領域と反射領域のフィルタ部分の光学特性を別々に設定する場合と同等のカラー品位を実現することができる。そして、上記比較例に対しては、ＲＧＢ各色についてそれぞれ２回ずつのパターニング（例えばフォトリソグラフィ・プロセス）を必要としないので、製造コストを大幅に低減できるという利点を有する。

【０１１９】上記構成例８～１５に示すように、前記反射層の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることが好ましい。これは、反射層の開口部の面積が異なる色の着色層を備えた画素間で同一に構成されていることにより、各色の画素において入射光量を等しくすることができるため、透過表示の色調整を比較的簡単に行うことが可能になるからである。例えば、透過領域を構成する開口面積がＲＧＢ各色で相互に同一であるため、色の発現態様は透過型表示装置と同様であるから、ＲＧＢ各色の着色層について、透過型表示装置に用いられるカラーフィルタの色材を基準にして適宜調整して色材の光学特性を設定することができる。また、反射部の面積についても異なる色の着色層を備えた画素間で同一に構成されるので、反射表示の色調整を行う際に、各色に対する着色層の反射部上の面積を調整しやすくなる。例えば、反射領域を構成する反射部面積がＲＧＢ各色で相互に同一であるため、色の発現態様は反射型表示装置と同様であるから、ＲＧＢ各色の着色層について、反射型表示装置に用いられるカラーフィルタを基準にして適宜調整して被覆面積率を設定することができる。

【０１２０】上記構成例では、前記着色層の前記反射部上の被覆面積率は、少なくとも２つの異なる色の前記着色層を備えた前記画素間で異なっている。これにより、開口部の透過光によって実現される透過表示の色を最適化するように各色の着色層の光学特性を調整するとともに、反射部と重なる各色の着色層の被覆面積率を調整することにより反射表示の色を最適化するといったことが可能になる。したがって、各色についてそれぞれ透過表示の色と反射表示の色とを独立に調整することができる。

【０１２１】赤、緑、青の各色の着色層を備えている場合には、緑の着色層の被覆面積率を赤及び青の着色層の被覆面積率よりも小さくすることにより、反射表示における彩度の低下を抑制しつつ明るさを向上することができる。透過表示は、開口部と重なる領域において着色層を１回だけ透過した光により構成されるが、反射表示は、反射部と重なる領域において着色層を２回透過する光により主として構成され、開口部と重なる領域にある着色層の部分で反射された反射光にも部分的に影響されるので、一般的に反射表示は透過表示よりも彩度が高くなる反面、暗くなりやすい。したがって、反射表示においては、着色層の光学特性として、彩度を多少低下させても、明度を高める必要がある。

【０１２２】ところが、特に、比視感度は波長５５５ｎｍでピークを有することから同じ光エネルギー量であっても緑色や黄色は赤色や青色よりも明るく見えることになるため、各色毎に彩度と明度との関係は異なる。例えば、赤（Ｒ画素）や青（Ｂ画素）の着色層を明るくするためには、赤や青の波長域の光エネルギーを大幅に増大させない限り、赤や青以外の光（比視感度の高い緑色や

黄色の光）を増やすしか方法はないから、全体の光量が限られている場合には、明度の向上に値しない大幅な彩度の低下を招いてしまう。これに対して、比視感度の高い波長域を主体とする緑（G画素）の場合には彩度を上げても暗くなりにくいため、明度を高めても彩度が大幅に低下することはない。

【０１２３】本発明の場合には、着色層の反射部上の被覆面積率を調整することによって、反射表示における彩度と明度の両立を図っている。この場合、R画素やB画素においては、被覆面積率を大きく低下させると明るくはなるものの彩度が急激に低下するため、被覆面積率は６０～１００％と高く設定することが好ましい。一方、G画素においては、被覆面積率を低下させることにより、反射光に緑以外の赤や青の波長域の光が含まれることとなるが、これらの他の波長域に対して比視感度に大きな差があるためにそれほど彩度は低下しないので、被覆面積率としては３５～５０％と低く設定することが好ましい。緑の被覆面積率と赤及び青の被覆面積率を上記範囲に設定することにより、透過表示の色再現性を確保しつつ、反射表示の色再現性及び明度を向上させることができる。

【０１２４】上記構成例においてはいずれも反射部が開口部の全周囲に配置されている。すなわち、反射層において開口部が反射部により取り囲まれた状態に形成されている。したがって、着色層と反射層との間に多少の位置ずれが発生したとしても、着色層で覆われない領域が開口部に生じないようにすることができる。特に、開口部が反射層の略中央に形成されていることにより、反射層の中央部分及びその周囲に重なるように着色層を形成することができるため、パターニング誤差等に対してカラーフィルタの光学性能が影響を受け難くなり、安定した生産が可能になる。

【０１２５】開口部による反射層に対する開口率は３０～７０％であることが好ましい。一般に、反射層の開口率が大きくなると透過表示は明るくなるが、反射表示は逆に暗くなるので、透過表示と反射表示のバランスを採るように反射層の開口率を設定する必要がある。より具体的には、開口率が小さすぎると、バックライトの照度を高くする必要があり、バックライトの消費電力が増大する。また、開口率が大きすぎると、反射表示が暗くなり視認しにくくなる。本実施形態では、反射部の一部に着色層と重ならない領域が設けられることにより反射表示の明るさをかせぐことができるので、反射層全体に着色層を重ねた構造を採用する場合に較べて、開口率が大きい上記範囲で透過表示と反射表示のバランスをとることが可能になり、透過表示と反射表示の双方において良好なカラー品位を実現することができる。開口率が上記範囲を下回ると、透過表示の明度を確保する必要から消費電力が増大するので携帯電話等の携帯型電子機器には採用しにくくなる。また、開口率が上記範囲を上回ると、反射表示における明度と彩度の両立が困難になり、反射表示におけるカラー品位を確保することが難しくなる。

【０１２６】［電子機器の実施形態］上記液晶パネルを含む電気光学装置を電子機器の表示装置として用いる場合の実施形態について説明する。図１８は、本実施形態の全体構成を示す概略構成図である。ここに示す電子機器は、上記と同様の液晶パネル２００と、これを制御する制御手段１２００とを有する。ここでは、液晶パネル２００を、パネル構造体２００Aと、半導体ＩＣ等で構成される駆動回路２００Bとに概念的に分けて描いてある。また、制御手段１２００は、表示情報出力源１２１０と、表示処理回路１２２０と、電源回路１２３０と、タイミングジェネレータ１２４０とを有する。

【０１２７】表示情報出力源１２１０は、ＲＯＭ（Read Only Memory）やＲＡＭ（Random Access Memory）等からなるメモリと、磁気記録ディスクや光記録ディスク等からなるストレージユニットと、デジタル画像信号を同調出力する同調回路とを備え、タイミングジェネレータ１２４０によって生成された各種のクロック信号に基づいて、所定フォーマットの画像信号等の形で表示情報を表示情報処理回路１２２０に供給するように構成されている。

【０１２８】表示情報処理回路１２２０は、シリアルーパラレル変換回路、増幅・反転回路、ローテーション回路、ガンマ補正回路、クランプ回路等の周知の各種回路を備え、入力した表示情報の処理を実行して、その画像情報をクロック信号ＣＬＫと共に駆動回路２００Bへ供給する。駆動回路２００Bは、走査線駆動回路、データ線駆動回路及び検査回路を含む。また、電源回路１２３０は、上述の各構成要素にそれぞれ所定の電圧を供給する。

【０１２９】図１９は、本発明に係る電子機器の一実施形態である携帯電話を示す。この携帯電話２０００は、ケース体２０１０の内部に回路基板２００１が配置され、この回路基板２００１に対して上述の液晶パネル２００が実装されている。ケース体２０１０の前面には操作ボタン２０２０が配列され、また、一端部からアンテナ２０３０が出没自在に取付けられている。受話部２０４０の内部にはスピーカが配置され、送話部２０５０の内部にはマイクが内蔵されている。

【０１３０】ケース体２０１０内に設置された液晶パネル２００は、表示窓２０６０を通して表示面（上記の液晶表示領域A）を視認することができるように構成されている。

【０１３１】尚、本発明の電気光学装置及び電子機器は、上述の図示例にのみ限定されるものではなく、本発明の要旨を逸脱しない範囲内において種々変更を加え得ることは勿論である。例えば、上記各実施形態に示す液晶パネルは単純マトリクス型の構造を備えているが、T

ＦＴ（薄膜トランジスタ）やＴＦＤ（薄膜ダイオード）等のアクティブ素子（能動素子）を用いたアクティブマトリクス方式の液晶装置にも適用することができる。また、上記実施形態の液晶パネルは所謂ＣＯＧタイプの構造を有しているが、ＩＣチップを直接実装する構造ではない液晶パネル、例えば液晶パネルにフレキシブル配線基板やＴＡＢ基板を接続するように構成されたものであっても構わない。

【０１３２】上述した実施形態では、電気光学装置として、液晶装置に適用した場合について説明したが、本発明はこれに限定されず、エレクトロルミネッセンス装置、特に、有機エレクトロルミネッセンス装置、無機エレクトロルミネッセンス装置等や、プラズマディスプレイ装置、ＦＥＤ（フィールドエミッションディスプレイ）装置、ＬＥＤ（発光ダイオード）表示装置、電気泳動表示装置、薄型のブラウン管、液晶シャッター等を用いた小型テレビ、デジタルマイクロミラーデバイス（ＤＭＤ）を用いた装置などの各種の電気光学装置に適用できる。

【０１３３】

【発明の効果】以上、説明したように本発明によれば、反射型表示の明るさを確保しつつ透過型表示の彩度を向上できる。また、反射型表示と透過型表示との間の色彩の差異を低減できる。

【図面の簡単な説明】

【図１】　本発明に係る電気光学装置の第１実施形態における液晶パネル２００の外観を示す液晶パネルの概略斜視図である。

【図２】　第１実施形態の断面構造を模式的に示す概略断面図（ａ）及びカラーフィルタ基板の概略拡大平面図（ｂ）である。

【図３】　本発明に係る電気光学装置の第２実施形態における液晶パネル３００の断面構造を模式的に示す概略断面図（ａ）及びカラーフィルタ基板の概略拡大平面図（ｂ）である。

【図４】　本発明に係る電気光学装置の第３実施形態における液晶パネル４００の断面構造を模式的に示す概略断面図（ａ）及びカラーフィルタ基板の概略拡大平面図（ｂ）である。

【図５】　その他の構成例１～４の反射層と着色層との重なり状態を模式的に示す概略説明図（ａ）～（ｄ）である。

【図６】　その他の構成例５～７の反射層と着色層との重なり状態を模式的に示す概略説明図（ａ）～（ｃ）、及び構成例７の概略断面図（ｄ）である。

【図７】　本発明に係る構成例８の構成を模式的に示す概略説明図である。

【図８】　本発明に係る構成例９の構成を模式的に示す概略説明図である。

【図９】　本発明に係る構成例１０の構成を模式的に示す概略説明図である。

【図１０】　本発明に係る構成例１１の構成を模式的に示す概略説明図である。

【図１１】　本発明に係る構成例１２の構成を模式的に示す概略説明図である。

【図１２】　本発明に係る構成例１３の構成を模式的に示す概略説明図である。

【図１３】　本発明に係る構成例１４の構成を模式的に示す概略説明図である。

【図１４】　本発明に係る構成例１５の構成を模式的に示す概略説明図である。

【図１５】　構成例８～１１の着色層と６段プロセスの比較例の色データとを比較して示すｘｙ色度図である。

【図１６】　１９３１ＣＩＥｘｙｚ表色系の色度図である。

【図１７】　着色層の分光透過率を示すグラフ（ａ）及び（ｂ）である。

【図１８】　本発明に係る電子機器の実施形態のブロック構成を示す概略構成図である。

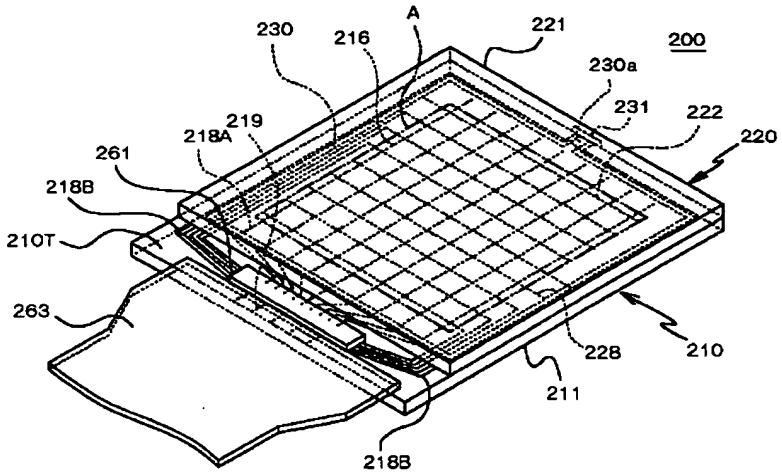
【図１９】　同電子機器の実施形態の外観を示す概略斜視図である。

【図２０】　従来の反射半透過型液晶パネルの構造を模式的に示す概略断面図である。

【符号の説明】

２００　液晶パネル
２１１　第１基板
２１２　反射層
２１２ａ　開口部
２１２ｂ　反射部
２１４　着色層
２１５　表面保護層
２１６　透明電極
２２１　第２基板
２２２　透明電極
２３０　シール材
２４０，２５０　偏光板

【図1】


A
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219
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218B
210T
263
228
210
211
218B

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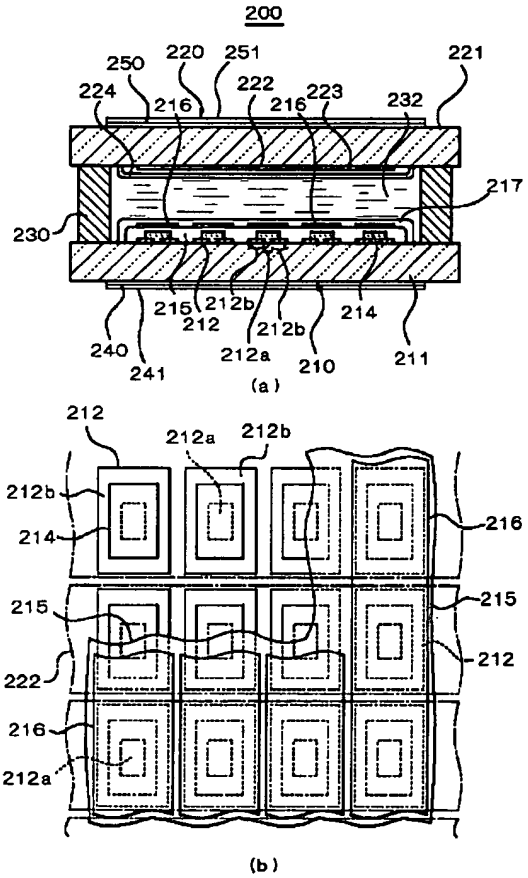
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212b
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215
222
212
216
212a
(b)

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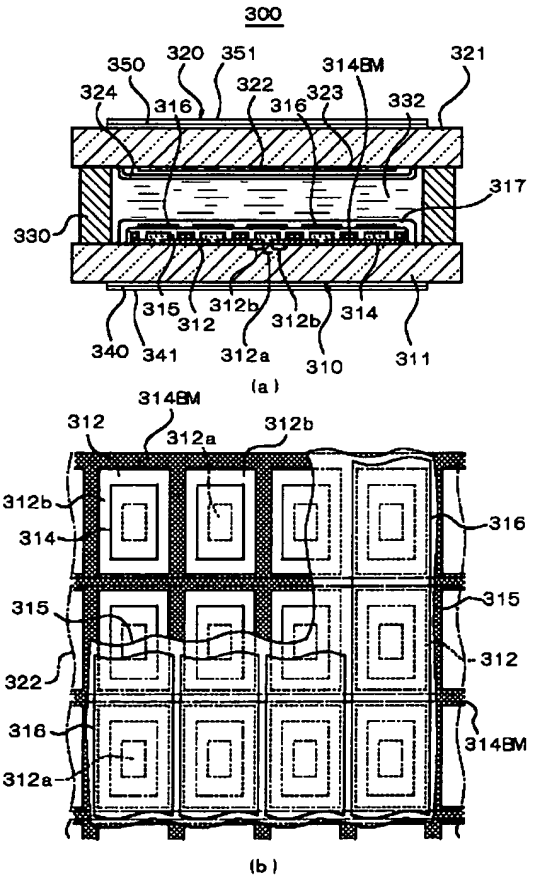
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341
312a
310
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312
316
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312a
(b)

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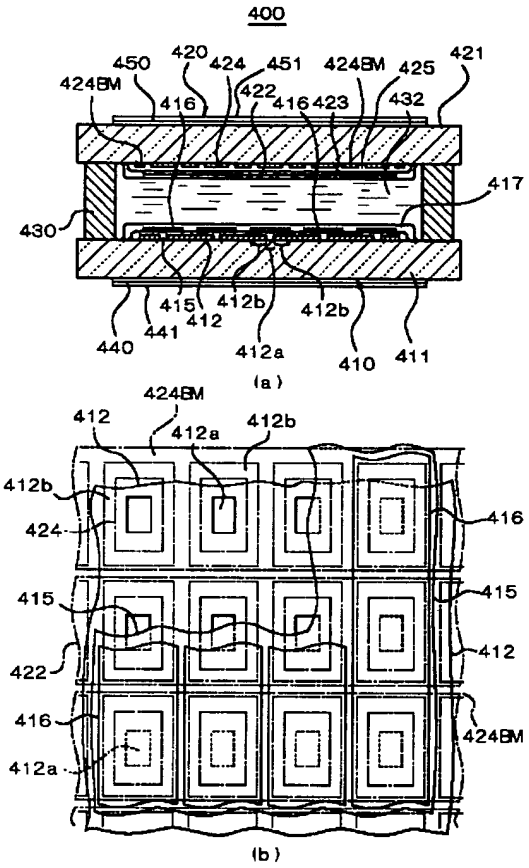

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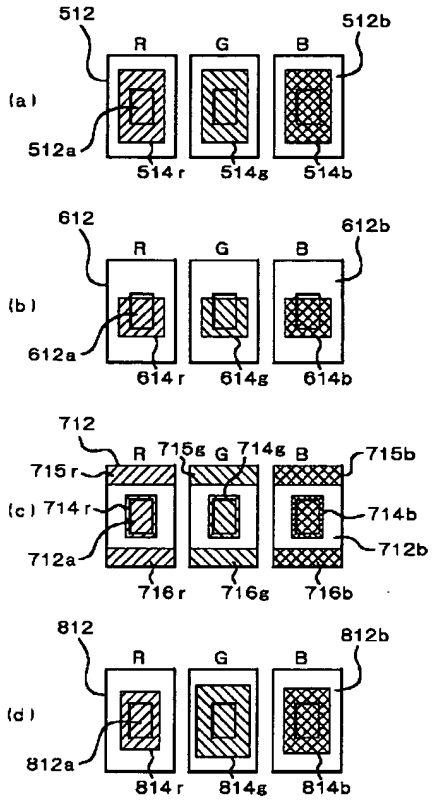

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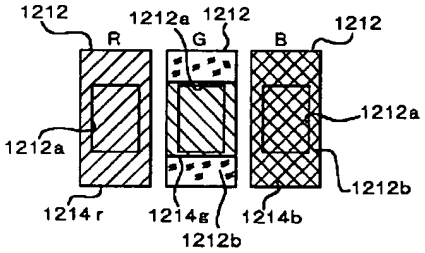

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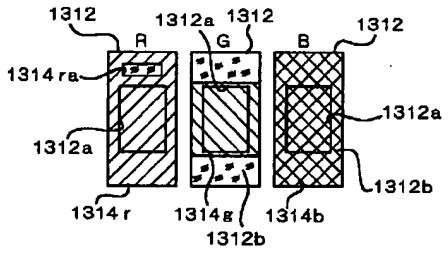

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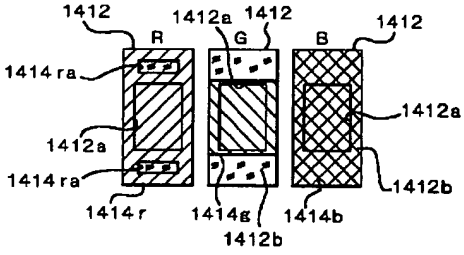

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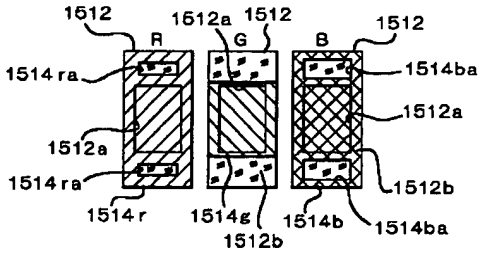

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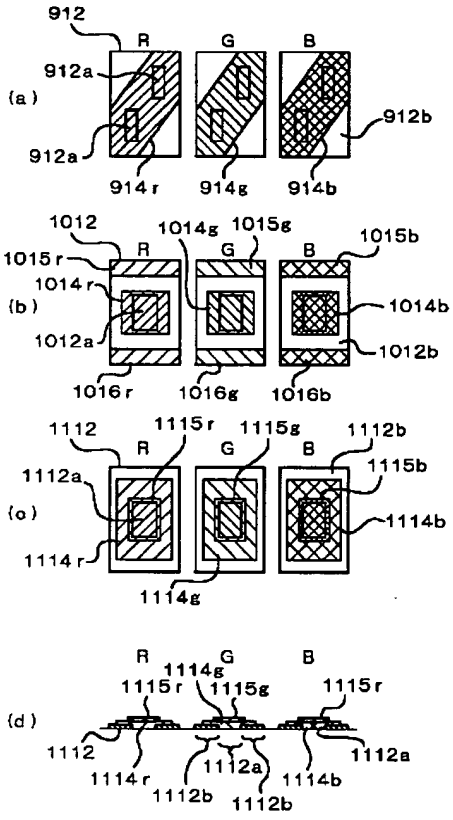

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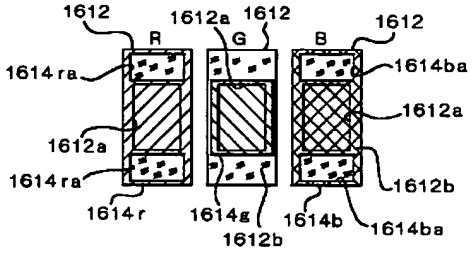

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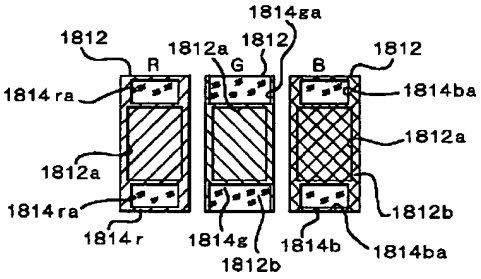

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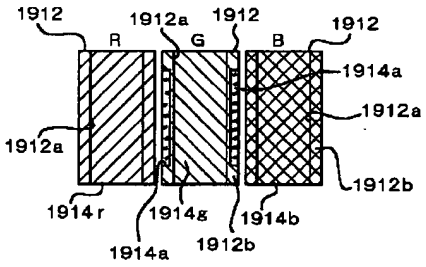

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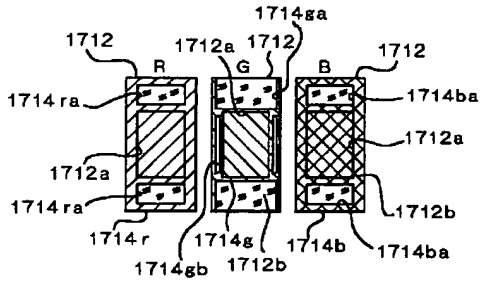

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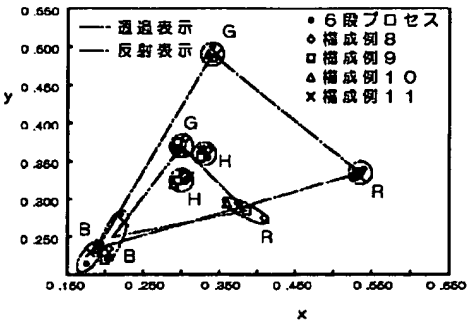

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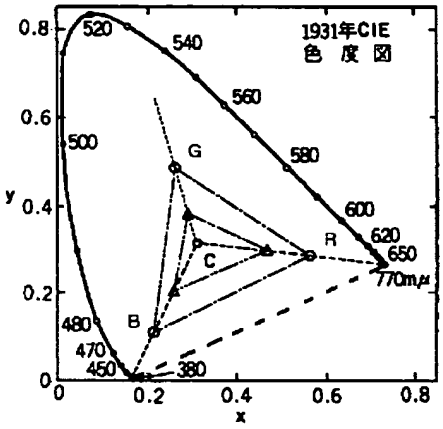

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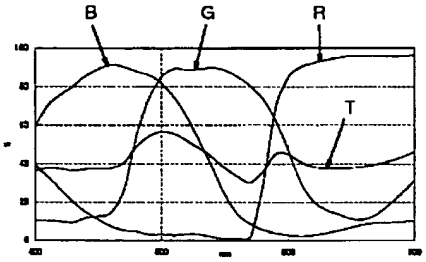

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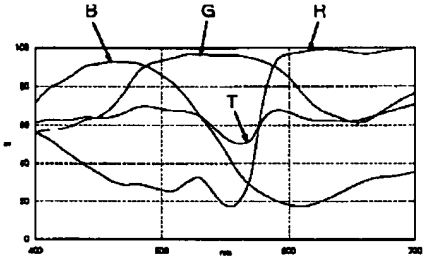

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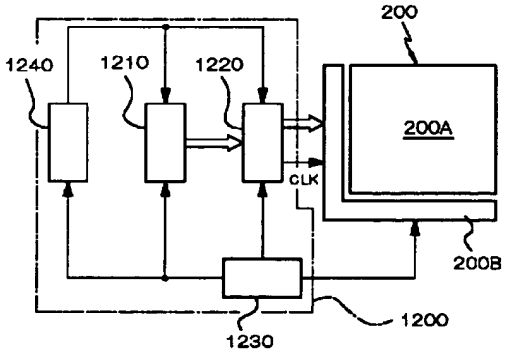

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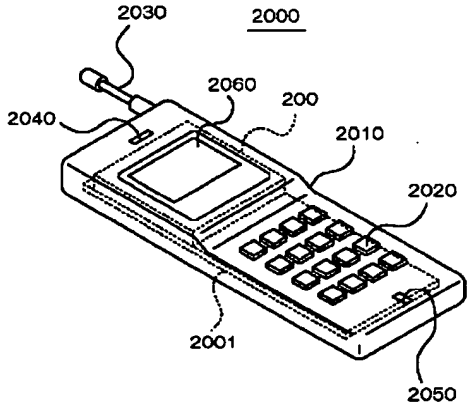

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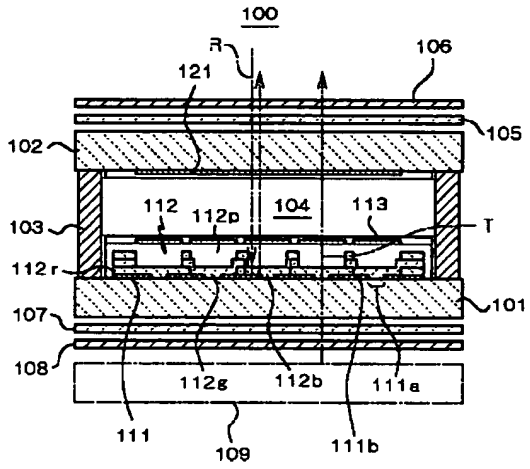

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Ｆターム(参考)　2H048 BA02 BA45 BB02 BB07 BB08
BB10 BB37 BB42
2H091 FA02Y FA14Y FD04 FD06
GA01

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The electrooptic material layer arranged between the substrates of a couple in an electro-optic device, The coloring layer arranged between one substrate and said electrooptic material layer among the substrates of said couple, It is the electro-optic device characterized by being arranged only in the part on said reflective section while having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening.
[Claim 2] The ratio of the area of said reflective section by which said coloring layer to the area of said reflective section is arranged is an electro-optic device according to claim 1 characterized by being smaller than the ratio of the area of said opening by which said coloring layer to the area of said opening is arranged.
[Claim 3] Said coloring layer is an electro-optic device according to claim 1 or 2 characterized by being arranged so that said opening may be covered thoroughly.
[Claim 4] Said coloring layer is an electro-optic device according to claim 1 or 2 characterized by being arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening.
[Claim 5] The electrooptic material layer arranged between the electrode for a display of a couple, and the electrode for a display of said couple in an electro-optic device, Two or more pixels arranged corresponding to the superficial lap field of the electrode for a display of said couple, It is arranged the coloring layer arranged in each of said pixel, and in each of said pixel. It is the electro-optic device characterized by being arranged in the part on said reflective section while having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening.
[Claim 6] the electro-optic device according to claim 5 characterized by said two or more pixels being alike, respectively, and the area of said coloring layer corresponding to [the area of said corresponding opening is substantially the same mutually and] at least one of said two or more of the pixels differing from the area of said coloring layer corresponding to said two or more other pixels.
[Claim 7] The electrooptic material layer arranged on two or more pixels in an electro-optic device, Two or more kinds of coloring layers which have been arranged on said pixel and which have a color which is mutually different, While being arranged on each of said pixel, having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening and said reflective section The electro-optic device characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].
[Claim 8] The area of opening of said reflecting layer is an electro-optic device according to claim 7 characterized by being identically constituted between said pixels equipped with said coloring layer of a different color.
[Claim 9] The rate of coat area on said reflective section of said coloring layer is an electro-optic device according to claim 7 characterized by differing between said pixels equipped with said coloring layer of

at least two different colors.
[Claim 10] It is the electro-optic device according to claim 9 characterized by having red, green, and said coloring layer of each blue color, and said rate of coat area of said green coloring layer being smaller than said rate of coat area of red and said blue coloring layer.
[Claim 11] It is the electro-optic device according to claim 10 which said rate of coat area of said green coloring layer is 30 - 50%, and is characterized by said rate of coat area of red and said blue coloring layer being 60 - 100%.
[Claim 12] Said reflective section is an electro-optic device according to claim 1, 5, or 7 characterized by being arranged in the perimeter enclosure of said opening.
[Claim 13] The numerical aperture to said reflecting layer by said opening is an electro-optic device according to claim 1, 5, or 7 characterized by being 30 - 70%.
[Claim 14] Electronic equipment characterized by having an electro-optic device according to claim 1, 5, or 7 and the control means which controls this electro-optic device.
[Claim 15] It is the light filter substrate characterized by being arranged only in the part on said reflective section while being arranged on a substrate and said substrate, having the reflecting layer which has the reflective section which reflects light, and opening, and the coloring layer arranged on said substrate in a light filter substrate and arranging said coloring layer on said opening.
[Claim 16] The substrate with which the pixel was set up in the light filter substrate, and the coloring layer arranged on said substrate according to said pixel, It is the light filter substrate characterized by being arranged at least in the part on said reflective section while being arranged on said substrate according to said pixel, having the reflecting layer which has the reflective section which reflects light, and opening and arranging said coloring layer on said opening.
[Claim 17] The substrate with which the pixel was set up in the light filter substrate, and two or more kinds of coloring layers which have been arranged on said substrate according to said pixel and which have a color which is mutually different, While being arranged on said substrate according to said pixel, having the reflecting layer which has the reflective section which reflects light, and opening and arranging said coloring layer on said opening and said reflective section The light filter substrate characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].

[Translation done.]

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3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an electro-optic device, a light filter substrate, and electronic equipment, and relates to a technique suitable as structure of a color electro-optic device of having a reflecting layer especially.
[0002]
[Description of the Prior Art] The liquid crystal display panel of a reflective transflective type whose check by looking of all of the reflective mold display using outdoor daylight and the transparency mold display using illumination light, such as a back light, was enabled from the former is known. The liquid crystal display panel of this reflective transflective type has a reflecting layer for reflecting outdoor daylight in that panel, and it constitutes it so that illumination light, such as a back light, can penetrate this reflecting layer. As this kind of a reflecting layer, there are some which were equipped with opening (slit) of predetermined area for every pixel of a liquid crystal display panel.
[0003] Drawing 20 is the outline sectional view showing typically the outline structure of the conventional liquid crystal display panel 100 of a reflective transflective type. This liquid crystal display panel 100 is equipped with the structure which the substrate 101 and the substrate 102 were stuck by the sealant 103, and enclosed liquid crystal 104 between the substrate 101 and the substrate 102.
[0004] On the inner surface of a substrate 101, the reflecting layer 111 which has opening 111a and reflective section 111b for every pixel is formed, and the light filter 112 equipped with the coloring layers 112r, 112g, and 112b and surface protective layer 112p on this reflecting layer 111 is formed. The transparent electrode 113 is formed on the front face of surface protective layer 112p of a light filter 112.
[0005] On the other hand, a transparent electrode 121 is formed on the inner surface of a substrate 102, and it is constituted so that the above-mentioned transparent electrode 113 on the substrate 101 which counters may be intersected. In addition, on a substrate 101 and a substrate 102, the orientation film, a hard transparent membrane, etc. are formed suitably if needed.
[0006] Moreover, on the outside surface of the above-mentioned substrate 102, sequential arrangement of the phase contrast plate (quarter-wave length plate) 105 and the polarizing plate 106 is carried out, and sequential arrangement of the phase contrast plate (quarter-wave length plate) 107 and the polarizing plate 108 is carried out on the outside surface of a substrate 101.
[0007] The liquid crystal display panel 100 constituted as mentioned above is attached back [the] in the condition that the back light 109 has been arranged, when installed in electronic equipment, such as a cellular phone and a personal digital assistant. In this liquid crystal display panel 100, since it is reflected in reflective section 111b, liquid crystal 104 is penetrated again and it is emitted after outdoor daylight penetrates liquid crystal 104 along a reflex path R in bright locations, such as day ranges and indoor, a reflective mold display is checked by looking. Since the light which passed opening 111a among the illumination light of a back light 109 by on the other hand making a back light 109 turn on in dark locations, such as night and the outdoors, passes the liquid crystal display panel 100 and is emitted

in accordance with the transparency path T, a transparency mold display is checked by looking.
[0008]
[Problem(s) to be Solved by the Invention] However, in order that light may pass a light filter 112 only at once in the above-mentioned transparency path T to light passing a light filter 112 twice, the lightness of a reflective mold display falls compared with the lightness of a transparency mold display, and there is a trouble that the saturation in a transparency mold display worsens to the saturation of a reflective mold display in the above-mentioned reflex path R, in the liquid crystal display panel 100 of a reflective transflective type of the above-mentioned former. When it does in this way, it becomes impossible that is, to obtain sufficient saturation in a transparency mold display, although it is necessary to set up the light transmittance of a light filter 112 highly, and to secure the brightness of a display since the brightness of a display generally tends to be insufficient in the reflective mold display.
[0009] Moreover, since the counts to which light passes a light filter in a reflective mold display and a transparency mold display as mentioned above differ and the color of a reflective mold display differs from the color of a transparency mold display greatly, there is also a trouble of giving sense of incongruity.
[0010] Then, this invention solves the above-mentioned trouble, and the technical problem is in offering the possible light filter substrate of securing both the brightness of a reflective mold display, and the saturation of a transparency mold display, when the both sides of a reflective mold display and a transparency mold display are used for the display made possible. Moreover, it is in offering the possible electro-optic device of a reflective transflective type of securing both the brightness of a reflective mold display, and the saturation of a transparency mold display. Furthermore, it aims at realizing the display technique in which the difference in the color between the transparency mold displays with a reflective mold display can be reduced.
[0011]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention person found out that the brightness of the reflected light reflected by the reflecting layer concerned was securable by constituting so that a coloring layer may lap superficially with a part of reflecting layer, and constituting so that a coloring layer may not lap with the part of others of a reflecting layer.
[0012] Especially, in the case of the electro-optic device of a reflective transflective type, after preparing the reflecting layer equipped with optical opening, while it constitutes so that a coloring layer may lap with optical opening selectively at least, the saturation of a transparency mold display can be raised by constituting so that a coloring layer may lap with a part of reflecting layer, securing the brightness of a reflective mold display.
[0013] The coloring layer is beforehand set as the predetermined depth of shade, and the brightness of a reflective mold display can be secured by adjusting after that the rate that a coloring layer laps with a reflecting layer so that a transparency mold display may more specifically be obtained good, where a coloring layer is put on optical opening.
[0014] The electrooptic material layer by which the electro-optic device of this invention has been arranged between the substrates of a couple (for example, liquid crystal layer), The coloring layer arranged between one substrate and said electrooptic material layer among the substrates of said couple, While having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening, it is characterized by being arranged only in the part on said reflective section.
[0015] Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while according to this invention the coloring layer is arranged on opening and it becomes possible to adjust the brightness of the reflected light by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.
[0016] As for the ratio (only henceforth a "reflective coloring ratio") of the area of the part of said

reflective section which laps with said coloring layer to the area of said reflecting layer here, it is desirable that it is smaller than the ratio (only henceforth a "transparency coloring ratio") of the area of the part of said opening which laps with said coloring layer to the area of said opening. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once the brightness of the reflected light can be raised by making a reflective coloring ratio smaller than a transparency coloring ratio -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced.

[0017] Moreover, it is desirable to be arranged so that said coloring layer may cover said opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[0018] Here, said reflecting layer and said coloring layer may be arranged on said one substrate among the substrates of said couple, and said reflecting layer may be arranged on said one substrate among the substrates of said couple, and said coloring layer may be arranged on the substrate of another side among the substrates of said couple. Even if it is which case, the same operation effectiveness can be acquired optically.

[0019] Moreover, as for said coloring layer, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. By arranging the coloring layer so that it may jut out of on opening on the reflective section of the perimeter, it becomes possible to form a coloring layer as a thing of one. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.

[0020] Moreover, the electrooptic material layer by which another electro-optic device of this invention has been arranged on two or more pixels, It is arranged the coloring layer arranged on each of said pixel, and on each of said pixel. While having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening, it is characterized by being arranged only in the part on said reflective section.

[0021] By according to this invention, being arranged in two or more pixels, only in the part on the reflective section, while the coloring layer is arranged on opening Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while becoming possible to adjust the brightness of the reflected light for every pixel according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually for every pixel.

[0022] As for the ratio of the area of the part of said reflective section which laps with said coloring layer to the whole surface product of said reflective section in each of said pixel here, it is desirable that it is smaller than the ratio of the area of the part of said opening which laps with said coloring layer to the whole surface product of said opening. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once by making a reflective coloring ratio smaller than a transparency coloring ratio, the brightness of the reflected light can be raised for every pixel -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced for every pixel.

[0023] Moreover, it is desirable to be arranged so that said coloring layer may cover said opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[0024] Furthermore, it has the substrate of the couple which pinched said electrooptic material layer, and

said reflecting layer and said coloring layer may be arranged on one substrate among the substrates of said couple, and said reflecting layer may be arranged on said one substrate among the substrates of said couple, and said coloring layer may be arranged on said substrate of another side among the substrates of said couple. Even if it is which case, the same operation effectiveness can be acquired optically.
[0025] Moreover, as for said coloring layer, in each of said pixel, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. Since according to this a coloring layer can be prepared so that it may become the integral construction jutted out on said surrounding reflecting layer from the field which laps with opening superficially for every pixel, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.
[0026] Moreover, the electrooptic material layer by which the electro-optic device with which this inventions differ has been arranged between the electrode for a display of a couple, and the electrode for a display of said couple, Two or more pixels arranged corresponding to the superficial lap field of the electrode for a display of said couple, It is arranged the coloring layer arranged in each of said pixel, and in each of said pixel. While having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening, it is characterized by being arranged in the part on said reflective section.
[0027] In this case, the area of said opening corresponding to each of two or more of said pixels is substantially the same mutually, and it is [the area of said coloring layer corresponding to at least one of said two or more of the pixels] desirable to differ from the area of said coloring layer corresponding to said two or more other pixels.
[0028] Furthermore, the electrooptic material layer by which another electro-optic device of this invention has been arranged on two or more pixels, Two or more kinds of coloring layers which have been arranged on said pixel and which have a color which is mutually different, While being arranged on each of said pixel, having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening and said reflective section It is characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].
[0029] As for the area of opening of said reflecting layer, in this invention, it is desirable to be identically constituted between said pixels equipped with said coloring layer of a different color. Since the amount of incident light can be made equal in the pixel of each color by being identically constituted between the pixels equipped with the coloring layer of the color from which the area of opening of a reflecting layer differs, it becomes possible to perform color adjustment of a transparency display comparatively simply. Moreover, since it is identically constituted between the pixels equipped with the coloring layer of a color which is different also about the area of the reflective section, in case color adjustment of a reflective display is performed, it becomes easy to adjust the area on the reflective section of the coloring layer to each color.
[0030] As for the rate of coat area on said reflective section of said coloring layer (equivalent to the above-mentioned reflective coloring ratio), in this invention, it is desirable to differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that this may optimize the color of the transparency display realized by the transmitted light of opening, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.
[0031] In this invention, it has red, green, and said coloring layer of each blue color, and, as for said rate of coat area of said green coloring layer, it is desirable that it is smaller than said rate of coat area of red and said blue coloring layer. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field which laps with opening, a reflective display is

mainly constituted by the light which penetrates a coloring layer twice in the field which laps with the reflective section, and is influenced by the reflected light by the coloring layer in the field which laps with opening selectively. Therefore, generally, a reflective display tends to become dark, while saturation becomes high rather than a transparency display. By the way, even if relative luminous efficiency raises the saturation of a green light to an yellow-green wavelength field to becoming dark if the saturation of the light of red and blue goes up since it has a peak, it cannot become dark easily. Thereby, if it is going to raise lightness in a reflective display, it will become easy for especially the saturation of red or blue to fall. therefore, the pixel of red or blue -- setting -- the rate of coat area -- high -- carrying out (or [namely, / losing the area of the reflective section which does not lap with a coloring layer] -- or) It becomes possible to increase lightness substantially, securing [lessen, secure saturation, and] the color repeatability of a reflective display, if the amount of reflected lights is earned by what the rate of coat area is made low for in a green pixel (that is, the area of the reflective section which does not lap with a coloring layer is increased).

[0032] In this invention, said rate of coat area of said green coloring layer is 30 - 50%, and, as for said rate of coat area of red and said blue coloring layer, it is desirable that it is 60 - 100%. The color repeatability and lightness of a reflective display can be raised securing the color repeatability of a transparency display by setting the green rate of coat area, red, and the blue rate of coat area as the above-mentioned range. As a rate of coat area of an especially green coloring layer, it is most desirable that it is 85 - 100% of range as a rate of coat area of red and a blue coloring layer 35 to 45%.

[0033] As for said reflective section, in this invention, being arranged in the perimeter enclosure of said opening is desirable. Since it will be formed in the condition that opening was enclosed by the reflective section in the reflecting layer, by this, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated in opening. As for said especially opening, it is desirable to be formed in the center of abbreviation of said reflecting layer.

[0034] As for the numerical aperture to said reflecting layer by said opening, in this invention, it is desirable that it is 30 - 70%. Since a reflective display will generally become conversely dark although a transparency display becomes bright if the numerical aperture of a reflecting layer becomes large, it is necessary to set up the numerical aperture of a reflecting layer so that the balance of a transparency display and a reflective display may be taken. If a numerical aperture is too small, it is necessary to make the illuminance of a back light high, and, more specifically, the power consumption of a back light will increase. Moreover, if a numerical aperture is too large, a reflective display will become dark and it will be hard coming to check by looking. since the brightness of a reflective display can work by be establish the field which do not lap with a coloring layer in a part of reflective section with this operation gestalt , it become possible and take the balance of a transparency display and a reflective display in the above-mentioned range a numerical aperture be large in the range to the whole reflecting layer compared with the case adopt the structure piled up in the coloring layer can realize good color grace in the both sides of a transparency display and a reflective display . If a numerical aperture is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if a numerical aperture exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.
 [0035] The electronic equipment of this invention is characterized by having the electro-optic device of one of the above, and the control means which controls this electro-optic device. **s, such as the electronic equipment especially equipped with the liquid crystal display in which the color display as an electro-optic device is possible, for example, a cellular phone, a personal digital assistant, and image pick-up equipment that has a liquid crystal display function, are mentioned. By this, when using an electro-optic device as a display of electronic equipment, the difference of color with a reflective mold display and a transparency mold display can be reduced, and high display grace can be realized.

[0036] In addition, although what is necessary is to show the coloring mode of color suitable for each in

a reflective mold display and a transparency mold display, and just to be able to prepare the separate light filter in each, a common light filter must realize both displays actually. In this invention, by changing a reflective coloring ratio and a transparency coloring ratio mutually as mentioned above, even if a coloring layer is common, it becomes possible to set up independently the coloring mode of a reflective mold display, and the coloring mode of a transparency mold display.

[0037] Next, while arranging the light filter substrate of this invention on a substrate and said substrate, having the reflecting layer which has the reflective section which reflects light, and opening, and the coloring layer arranged on said substrate and arranging said coloring layer on said opening, it is characterized by being arranged only in the part on said reflective section.

[0038] Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while according to this invention the coloring layer is arranged on opening and it becomes possible to adjust the brightness of the reflected light by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.

[0039] As for the ratio of the area of said reflective section by which said coloring layer to the whole surface product of said reflective section is arranged here, it is desirable that it is smaller than the ratio of the area of said opening by which said coloring layer to the whole surface product of said opening is arranged. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once by making a reflective coloring ratio smaller than a transparency coloring ratio, the brightness of the reflected light can be raised for every pixel -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced for every pixel.

[0040] Moreover, it is desirable to be arranged so that said coloring layer may cover said target opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[0041] Furthermore, as for said coloring layer, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. By arranging the coloring layer so that it may jut out of on opening on the reflective section of the perimeter, it becomes possible to form a coloring layer as a thing of one. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.

[0042] Moreover, the substrate with which, as for another light filter substrate of this invention, the pixel was set up, While having the reflecting layer which has the coloring layer arranged on said substrate according to said pixel, the reflective section which is arranged on a substrate according to said pixel, and reflects light, and opening and arranging said coloring layer on said opening It is characterized by being arranged at least in the part on said reflective section.

[0043] Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while according to this invention the coloring layer is arranged on opening and it becomes possible to adjust the brightness of the reflected light for every pixel by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.

[0044] As for the ratio of the area of said reflective section by which said coloring layer to the whole surface product of said reflective section has been arranged here, it is desirable that it is smaller than the ratio of the area of said opening by which said coloring layer to the whole surface product of said opening has been arranged. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light

penetrating a coloring layer twice penetrates a coloring layer only once by making a reflective coloring ratio smaller than a transparency coloring ratio, the brightness of the reflected light can be raised for every pixel -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced for every pixel.
[0045] Moreover, it is desirable to be arranged so that said coloring layer may cover said opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.
[0046] Furthermore, as for said coloring layer, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. By arranging the coloring layer so that it may jut out of on opening on the reflective section of the perimeter, it becomes possible to form a coloring layer as a thing of one. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.
[0047] Next, the substrate with which, as for another light filter substrate of this invention, the pixel was set up, Two or more kinds of coloring layers which have been arranged on said substrate according to said pixel and which have a color which is mutually different, While being arranged on said substrate according to said pixel, having the reflecting layer which has the reflective section which reflects light, and opening and arranging said coloring layer on said opening and said reflective section It is characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].
[0048] As for the area of opening of said reflecting layer, in this invention, it is desirable to be identically constituted between said pixels equipped with said coloring layer of a different color. Since the amount of incident light can be made equal in the pixel of each color by being identically constituted between the pixels equipped with the coloring layer of the color from which the area of opening of a reflecting layer differs, it becomes possible to perform color adjustment of a transparency display comparatively simply. Moreover, since it is identically constituted between the pixels equipped with the coloring layer of a color which is different also about the area of the reflective section, in case color adjustment of a reflective display is performed, it becomes easy to adjust the area on the reflective section of the coloring layer to each color.
[0049] Moreover, as for the rate of coat area on said reflective section of said coloring layer, it is desirable to differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that this may optimize the color of the transparency display realized by the transmitted light of opening, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.
[0050] In this case, it has red, green, and said coloring layer of each blue color, and, as for said rate of coat area of said green coloring layer, it is desirable that it is smaller than said rate of coat area of red and said blue coloring layer. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field which laps with opening, a reflective display is mainly constituted by the light which penetrates a coloring layer twice in the field which laps with the reflective section, and is influenced by the reflected light by the coloring layer in the field which laps with opening selectively. Therefore, generally, a reflective display tends to become dark, while saturation becomes high rather than a transparency display. By the way, even if relative luminous efficiency raises the saturation of a green light to an yellow-green wavelength field to becoming dark if the saturation of the light of red and blue goes up since it has a peak, it cannot become dark easily. Thereby, if it is going to raise lightness in a reflective display, it will become easy for especially the saturation of red or blue to fall. therefore, the pixel of red or blue -- setting -- the rate of coat area -- high -- carrying out (or [namely, / losing the area of the reflective section which does not lap with a coloring layer] -- or) It becomes possible to increase lightness substantially, securing [lessen, secure saturation, and] the color repeatability of a reflective display, if the amount of reflected lights is earned by what the rate of coat area is made low for in a green pixel (that is, the area of the reflective section which does not

lap with a coloring layer is increased).
[0051] Furthermore, said rate of coat area of said green coloring layer is 30 - 50%, and, as for said rate of coat area of red and said blue coloring layer, it is desirable that it is 60 - 100%. The color repeatability and lightness of a reflective display can be raised securing the color repeatability of a transparency display by setting the green rate of coat area, red, and the blue rate of coat area as the above-mentioned range. As a rate of coat area of an especially green coloring layer, it is most desirable that it is 85 - 100% of range as a rate of coat area of red and a blue coloring layer 35 to 45%.
[0052] Moreover, as for said reflective section, being arranged in the perimeter enclosure of said opening is desirable. Since it will be formed in the condition that opening was enclosed by the reflective section in the reflecting layer, by this, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated in opening. As for said especially opening, it is desirable to be formed in the center of abbreviation of said reflecting layer.
[0053] Furthermore, as for the numerical aperture to said reflecting layer by said opening, it is desirable that it is 30 - 70%. Since a reflective display will generally become conversely dark although a transparency display becomes bright if the numerical aperture of a reflecting layer becomes large, it is necessary to set up the numerical aperture of a reflecting layer so that the balance of a transparency display and a reflective display may be taken. If a numerical aperture is too small, it is necessary to make the illuminance of a back light high, and, more specifically, the power consumption of a back light will increase. Moreover, if a numerical aperture is too large, a reflective display will become dark and it will be hard coming to check by looking. Since the brightness of a reflective display can be earned by establishing the field which does not lap with a coloring layer in a part of reflective section with this operation gestalt It compares, when adopting the structure which put the coloring layer on the whole reflecting layer, or when it constitutes the coloring layer of an optical property which is different in the part which laps with the reflective section, and the part which laps with opening. In the above-mentioned range where a numerical aperture is large, it becomes possible to balance a transparency display and a reflective display, and good color grace can be realized in the both sides of a transparency display and a reflective display. If a numerical aperture is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if a numerical aperture exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.
[0054]
[Embodiment of the Invention] Next, the operation gestalt of the electro-optic device built over this invention with reference to an accompanying drawing, a light filter substrate, and electronic equipment is explained to a detail.
[0055] [1st operation gestalt] drawing 1 is the outline perspective view showing the appearance of the liquid crystal panel 200 which constitutes the electro-optic device of the 1st operation gestalt concerning this invention, and it is the amplification part plan of the light filter substrate 210 with which drawing 2 (a) constitutes the typical outline sectional view of a liquid crystal panel 200, and drawing 2 (b) constitutes a liquid crystal panel 200.
[0056] This electro-optic device comes suitably to attach lighting systems, case objects, etc. which are not illustrated if needed, such as a back light and a front light, to the liquid crystal panel 200 which has the so-called passive matrix mold structure of a reflective transflective method.
[0057] As shown in drawing 1 , the liquid crystal panel 200 is equipped with the cellular structure which it comes to close with a sealing agent 231, after the light filter substrate 210 which uses as a base the 1st transparent substrate 211 which consists of a glass plate, a synthetic-resin plate, etc., and the opposite substrate 220 which uses as a base the 2nd same substrate 221 which counters this are stuck through a sealant 230 and liquid crystal 232 is poured in from inlet 230a inside a sealant 230.
[0058] On the inner surface (front face which counters the 2nd substrate 221) of the 1st substrate 211,

the transparent electrode 216 of the shape of a stripe arranged in parallel is formed, and the transparent electrode 222 of the shape of a stripe arranged in parallel is formed on the inner surface of the 2nd substrate 221. [two or more] [two or more] Moreover, the above-mentioned transparent electrode 216 is connected conductively to wiring 218A, and the above-mentioned transparent electrode 222 is connected conductively to wiring 228. It intersects perpendicularly mutually, and the crossover field constitutes the pixel of a large number arranged in the shape of a matrix, and, as for a transparent electrode 216 and a transparent electrode 222, these pixel arrays constitute the liquid crystal display field A.

[0059] The 1st substrate 211 has substrate overhang section 210T which it comes to ****** outside the appearance of the 2nd substrate 221, and above-mentioned wiring 218A, wiring 218B connected conductively through the vertical flow section which consists of a part of sealants 230 to the above-mentioned wiring 228, and the input terminal section 219 which consists of two or more circuit patterns formed independently are formed on these substrate overhang section 210T. Moreover, on substrate overhang section 210T, the semiconductor IC 261 which built in the liquid crystal actuation circuit etc. is mounted so that it may be connected conductively to these wiring 218A and 218B and the input terminal section 219. Moreover, the flexible wiring substrate 263 is mounted in the edge of substrate overhang section 210T so that it may be connected conductively to the above-mentioned input terminal section 219.

[0060] In this liquid crystal panel 200, as shown in drawing 2 , in the outside surface of the 1st substrate 211, the phase contrast plate (quarter-wave length plate) 240 and a polarizing plate 241 are arranged, and the phase contrast plate (quarter-wave length plate) 250 and the polarizing plate 251 are arranged in the outside surface of the 2nd substrate 221.

[0061] The structure of the light filter substrate 210 is explained to a detail with reference to <the structure of the light filter substrate 210> next drawing 2 (a), and (b). A reflecting layer 212 is formed in the front face of the 1st substrate 211, and opening 212a is prepared for every above-mentioned pixel. It is reflective section 212b in which parts other than opening 212a reflect light substantially among this reflecting layer 212. In the case of this operation gestalt, the reflecting layer 212 which has opening 212a and reflective section 212b for every pixel is formed. But a reflecting layer 212 may be formed in the whole liquid crystal display field A, and only opening 212a may be formed for every pixel.

[0062] The coloring layer 214 was formed on the reflecting layer 212, and the surface protective layer (overcoat layer) 215 which consists of transparence resin etc. has covered a it top. A light filter is formed of this coloring layer 214 and the surface protective layer 215.

[0063] Into transparence resin, the coloring layer 214 shall distribute coloring matters, such as a pigment and a color, and shall usually present the predetermined color tone. Although there are some which consist of combination of three colors of R (red), G (green), and B (blue) as a primary color system filter as an example of the color tone of a coloring layer, it is not limited to this and can form in the various color tones of a complementary color system and others. Usually, the coloring layer which has a predetermined color pattern is formed by applying the coloring resist which consists of a photopolymer containing coloring matters, such as a pigment and a color, on a substrate front face, and removing a garbage by the photolithography method. Here, in forming the coloring layer of two or more color tones, it repeats the above-mentioned process.

[0064] In addition, although the stripe array is adopted as an array pattern of a coloring layer in the example of a graphic display shown in drawing 2 (b), various pattern configurations other than this stripe array, such as a delta array and a slanting mosaic array, are employable. Moreover, the light-shielding film (a black matrix or black mask) for shading the field between pixels can be formed in the perimeter of each coloring layer of Above RGB as a part of coloring layer.

[0065] On the surface protective layer 215, the transparent electrode 216 which consists of transparence conductors, such as ITO (indium stannic-acid ghost), is formed. A transparent electrode 216 is formed in band-like [which is extended to the graphic display up down one of drawing 2 (b)], and two or more transparent electrodes 216 arrange it in parallel mutually, and it is constituted in the shape of a stripe. On the transparent electrode 216, the orientation film 217 which consists of polyimide resin etc. is formed.

[0066] In this operation gestalt, while the coloring layer 214 which constitutes a light filter has lapped superficially so that opening 212a of a reflecting layer 212 may be thoroughly covered in each pixel as shown in drawing 2 (b), it is formed in one so that it may jut out of the field which laps with opening 212a superficially on reflective section 212b around opening 212a towards a perimeter.
[0067] Moreover, the coloring layer 214 is not formed in each whole pixel, and it is formed so that it may lap with a part of reflecting layer 212. That is, the field (inner circumference field which attends opening 212a in the example of a graphic display) which laps with the coloring layer 214 superficially, and the field (the example of a graphic display periphery field) which does not lap with the coloring layer 214 superficially exist in a reflecting layer 212.
[0068] On the other hand, in the above-mentioned liquid crystal panel 200, the above-mentioned light filter substrate 210 and the opposite substrate 220 which counters carry out the laminating of the hard protective coat 223 which consists of the same transparent electrode 222 as the above, SiO2, TiO2, etc. on the 2nd substrate 221 which consists of glass etc., and the same orientation film 224 as the above one by one.
[0069] In this operation gestalt constituted as mentioned above, it reflects in reflective section 212b, without reflecting in reflective section 212b and a part passing the coloring layer 214, after a part penetrates the coloring layer 214, and the outdoor daylight which carried out incidence to reflective section 212b from the opposite substrate 220 side penetrates and carries out outgoing radiation of the opposite substrate 220 again. Although the outdoor daylight which penetrates the coloring layer 214 passes the coloring layer 214 twice at this time, outgoing radiation of the outdoor daylight which does not penetrate the coloring layer 214 is carried out without passing the coloring layer 214. Therefore, the lightness of a reflective mold display can be raised compared with the case where the coloring layer 214 has covered the reflecting layer 212 whole in a pixel.
[0070] On the other hand, since the coloring layer 214 has covered all opening 212a of a reflecting layer 212, when the back light etc. is arranged, for example behind the light filter substrate 210 and the illumination light is irradiated from behind, a part of illumination light concerned passes opening 212a, it penetrates the coloring layer 214, and passes and carries out outgoing radiation of liquid crystal 232 and the opposite substrate 220. Therefore, in order that the transmitted light may penetrate the coloring layer 214 only once, the color of the transparency mold display according to the depth of shade (degree which gives a bias to the spectrum distribution of a light field when light is made to penetrate) of the coloring layer 214 is acquired. Since the reflected light component which does not pass a coloring layer as mentioned above is contained and the saturation of the reflected light falls at this time, the saturation of a transparency mold display increases relatively.
[0071] With this operation gestalt, the color of a reflective mold display, especially lightness are securable by forming the optical property of the coloring layer 214 so that it may correspond to a transparency mold display, and adjusting the reflector product of reflective section 212b which laps with the coloring layer 214 superficially. Therefore, the saturation of a transparency mold display can be raised, securing the brightness of a reflective mold display. Moreover, the difference in the color (it is especially saturation and lightness) a reflective mold display and a transparency mold display can also be reduced.
[0072] the above-mentioned effectiveness -- the production process of the usual light filter -- the same -- a coloring layer -- overall -- about -- while forming at Mr. one's depth of shade (for example, the concentration of coloring matters, such as a pigment and a color, -- about -- Mr. 1) -- a coloring layer -- overall -- about -- it is suitable especially when forming in Mr. one's thickness. In this case, conventionally, since the optical property of the field which laps with opening 212a in the coloring layer 214 superficially, and the field which laps with reflective section 212b in the coloring layer 214 superficially is mostly in agreement, since a difference of big saturation and lightness arises inevitably between the color of a reflective mold display, and the color of a transparency mold display, with structure, the effectiveness of this invention will become remarkable especially.
[0073] Although what is necessary is to show the coloring mode of color suitable for each in a reflective mold display and a transparency mold display, and just to be able to prepare the separate light filter in

each, it is desirable actually on manufacture to realize both displays with a common light filter. With this operation gestalt, by changing a reflective coloring ratio and a transparency coloring ratio mutually as mentioned above, even if the coloring layer was common, it became possible to set up independently the coloring mode of a reflective mold display, and the coloring mode of a transparency mold display.
[0074] The 2nd operation gestalt which starts this invention with reference to the [2nd operation gestalt] next drawing 3 (a), and (b) is explained. In the liquid crystal panel 300 of this operation gestalt, since it has the 1st same substrate 311 as the above-mentioned 1st operation gestalt, the 2nd substrate 321, the coloring layer 314, the surface protective layer 315, a transparent electrode 316, the orientation film 317, a transparent electrode 322, the hard protective coat 323, the orientation film 324, a sealant 330, liquid crystal 332, the phase contrast plate 340,350, and the polarizing plate 341,351, explanation is omitted about these.
[0075] In the liquid crystal panel 300 of this operation gestalt, the reflecting layer 312 is formed in one almost extensively in the liquid crystal display field, and opening 312a is prepared for every pixel. It is reflective section 312b in which parts other than opening 312a reflect light substantially among this reflecting layer 312. Moreover, black light-shielding film 314BM which consists of black resin etc. is formed in the field between pixels. The thing which distributed coloring matters, such as a black pigment and a color, in transparence resin as black resin, or the thing which was made to mix both the coloring matters of three colors of R (red), G (green), and B (blue), and was distributed in transparence resin is used.
[0076] Although the reflecting layer 312 should be continued for two or more pixels and it should be formed in one with this operation gestalt, a reflecting layer may be formed for every pixel like the 1st operation gestalt, and the above-mentioned black light-shielding film may be formed between reflecting layers.
[0077] The 3rd operation gestalt which starts this invention with reference to the [3rd operation gestalt] next drawing 4 (a), and (b) is explained. Since the liquid crystal panel 400 of this operation gestalt has the 1st same substrate 411 as the above-mentioned 2nd operation gestalt, the 2nd substrate 421, the reflecting layer 412 that has opening 412a and reflective section 412b, a transparent electrode 416, the orientation film 417, a transparent electrode 422, the orientation film 423, a sealant 430, liquid crystal 432, the phase contrast plate 440,450, and the polarizing plate 441,451, it omits explanation about these.

[0078] In this operation gestalt, as shown in drawing 4 (a), the light filter is formed not on the 1st substrate 421 with which the reflecting layer 412 was formed but on the 2nd substrate 421. On the 2nd substrate 421, the coloring layer 424 is formed for every pixel, and, more specifically, the same black light-shielding film 424BM as the 2nd operation gestalt is formed in the field between pixels. The transparent surface protective layer 425 is formed on the coloring layer 424 and black light-shielding film 424BM.
[0079] A transparent electrode 422 is formed on the above-mentioned surface protective layer 425, and the orientation film 423 is formed on this transparent electrode 422.
[0080] As shown in drawing 4 (b), to the reflective substrate 410 with which the reflecting layer 412 was formed, the coloring layer 424 (graphic display alternate long and short dash line) of the light filter substrate 420 laps with opening 412a of a reflecting layer 412 superficially, and it is constituted so that opening 412a may be covered thoroughly. Moreover, the coloring layer 424 is constituted by one so that it may ****** to the field which laps with reflective section 412b of a reflecting layer 412 towards a perimeter from the field which laps with opening 412a superficially. That is, the reflecting layer 412 is equipped with the field (the example of a graphic display inner circumference field) which laps with the coloring layer 424 superficially, and the field (the example of a graphic display periphery field) which does not lap with the coloring layer 424 superficially.
[0081] If the superficial lap mode of a reflecting layer 412 and the coloring layer 424 is constituted as mentioned above even if formed on the substrate with which a reflecting layer 412 differs from the coloring layer 424 like this operation gestalt, the same operation effectiveness as the 1st operation gestalt and the 2nd operation gestalt can be done so.

[0082] With reference to [the other examples of a configuration], next drawing 5 (a) - (d) and drawing 6 (a) - (d), the example of a configuration of others applicable to each above-mentioned operation gestalt is explained. Each example of a configuration explained below illustrates and explains only the superficial physical relationship of a reflecting layer and a coloring layer.
[0083] (Example 1 of a configuration) the coloring layer 514 which presents the hue of R (red) on the reflecting layer 512 equipped with opening 512a in each pixel in the example 1 of a configuration shown in drawing 5 (a) -- it is formed so that 514g of coloring layers which present the hue of r and G (green), and coloring layer 514b which presents the hue of B (blue) may lap superficially, respectively. Like each above-mentioned operation gestalt, it is constituted so that the coloring layers 514r, 514g, and 514b in each pixel may cover opening 512a thoroughly, respectively, and this example of a configuration is consisted of by one so that it may ****** to the field which laps with a surrounding reflector and a surrounding flat-surface target from the field which laps with opening 512a superficially.
[0084] (Example 2 of a configuration) the coloring layer 614 which presents the hue of R (red) on the reflecting layer 612 equipped with opening 612a in each pixel in the example 2 of a configuration shown in drawing 5 (b) -- it is formed so that 614g of coloring layers which present the hue of r and G (green), and coloring layer 614b which presents the hue of B (blue) may lap superficially, respectively. If each coloring layers 614r, 614g, and 614b cover opening 612a thoroughly, it does not break by this example of a configuration, but the field which does not lap with a coloring layer and a flat-surface target exists in a part of opening 612a.
[0085] In order to reduce the difference in the color a reflective mold display and a transparency mold display, it consists of this example 2 of a configuration so that a reflective coloring ratio (surface ratio of a field which laps with the coloring layer to total reflection area and the flat-surface target of a reflecting layer 612) may become smaller than a transparency coloring ratio (surface ratio of a field which laps with the coloring layer to full admission opening area and the flat-surface target of opening 612a). Consequently, the lightness of a reflective display improves and the saturation of a transparency mold display increases relatively.
[0086] (Example 3 of a configuration) In the example 3 of a configuration shown in drawing 5 (c) So that it may lap superficially on the reflecting layer 712 equipped with opening 712a in each pixel, respectively the coloring layers 714r, 715r, and 716 which present two or more hues of R (red), respectively -- the coloring layers 714g, 715g, and 716g which present the hue of r and G (green), and the coloring layers 714b, 715b, and 716b which present the hue of B (blue) are formed.
[0087] It consists of this example of a configuration so that the coloring layers 714r, 714g, and 714b may lap with opening 712a superficially and the other coloring layers 715r, 715g, 715b, 716r, 716g, and 716b may lap superficially only on the reflector of a reflecting layer 712. Thus, it may be constituted so that two or more coloring layers may lap superficially in each pixel, respectively.
[0088] (Example 4 of a configuration) the coloring layer 814 which presents the hue of R (red) on the reflecting layer 812 equipped with opening 812a in the example 4 of a configuration shown in drawing 5 (d) -- it is formed so that 814g of coloring layers which present the hue of r and G (green), and coloring layer 814b which presents the hue of B (blue) may lap superficially, respectively. It is the value from which it consisted of this example of a configuration so that the coloring layers 812r, 812g, and 812b might become area which is mutually different, consequently the reflective coloring ratio (ratio of the reflector product which lapped with the coloring layer to total reflection area and flat-surface target in a pixel) differed mutually according to the hues R (red), G (green), and B (blue) of a coloring layer. Speaking more generally, the ratio of the above-mentioned reflective coloring ratio and a transparency coloring ratio (ratio of opening area which lapped with the coloring layer to full admission opening area and flat-surface target in a pixel) serving as a value which is mutually different for every color.
[0089] It not only can set up independently the color of a reflective mold display and a transparency mold display like the above-mentioned operation gestalt or other examples of a configuration, but according to this example 4 of a configuration, according to the construction material of the coloring layer of each color, it can obtain suitable color by setting up the above-mentioned reflective coloring ratio (or ratio of a reflective coloring ratio and a transparency coloring ratio) for every color.

[0090] (Example 5 of a configuration) In the example 5 of a configuration shown in drawing 6 (a), opening 912a of plurality (the example of a graphic display two) is prepared for every pixel in the reflecting layer 912. It is reflective section 912b in which parts other than opening 912a reflect light substantially among this reflecting layer 912. And in two or more opening 912a, the coloring layers 914r, 914g, and 914b which lap with this reflecting layer 912 superficially are constituted, respectively so that it may lap superficially with a part of reflective section 912b with a wrap.
[0091] (Example 6 of a configuration) In the example 6 of a configuration shown in drawing 6 (b), the coloring layers 1014r, 1014g, 1014b, 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b of plurality (the example of a graphic display three) which lap with the reflecting layer 1012 which has opening 1012a and reflective section 1012b superficially are formed. Here, the coloring layers 1014r, 1014g, and 1014b are constituted so that it may lap with opening 1012a superficially, and the coloring layers 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b are constituted so that it may lap superficially with a part of reflective section. And the coloring layers 1014r, 1014g, and 1014b are constituted so that it may have the depth of shade higher than the coloring layers 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b, namely, so that coloring matters, such as a pigment and a color, may be included more in high concentration.
[0092] The optical concentration of the coloring layers 1014r, 1014g, and 1014b which lap with opening 1012a superficially in this example 6 of a configuration is high. Since the optical concentration of the coloring layers 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b constituted so that it might lap superficially with a part of reflective section 1012b is low Compared with the case of each above-mentioned operation gestalt, the saturation of the transmitted light becomes relative still higher, and the reflected light becomes still brighter.
[0093] As mentioned above, in this invention, the case where it constitutes so that the optical concentration of a coloring layer may differ selectively is not eliminated. About especially a coloring layer, it is desirable to make low optical concentration of the field which is high and laps the optical concentration of the field which laps with optical opening and the flat-surface target of a reflecting layer with the other reflecting layer and a flat-surface target.
[0094] (Example 7 of a configuration) In the example 7 of a configuration shown in drawing 6 (c), the coloring layers 1114r, 1114g, 1114b, 1115r, 1115g, and 1115b of plurality (the example of a graphic display two) which lap with the reflecting layer 1112 which has opening 1112a and reflective section 1112b superficially are formed. The coloring layers 1114r, 1114g, and 1114b and the coloring layers 1115r, 1115g, and 1115b are independently arranged so that laminating arrangement may be carried out mutually or it may lap mutually superficially. In addition, drawing 6 (d) shows the sectional view at the time of carrying out the laminating of a reflecting layer 1112, the coloring layers 1114r, 1114g, and 1114b, and the coloring layers 1115r, 1115g, and 1115b mutually, and making them form in it in this example 7 of a configuration.
[0095] The field with which the coloring layers 1114r, 1114g, and 1114b and the coloring layers 1115r, 1115g, and 1115b lap superficially in this example 7 of a configuration, Namely, it sets to the field which laps with opening 1112a superficially. The field which is in the field in which the thickness of a coloring layer is substantially thick and the coloring layers 1114r, 1114g, and 1114b are formed, and does not lap with the coloring layers 1115r, 1115g, and 1115b superficially, That is, in the field which laps with reflective section 1112b superficially, it is constituted so that the thickness of a coloring layer may become thin substantially. Therefore, the saturation of the transmitted light improves further by the thick coloring layer, and its lightness of the reflected light improves further by forming the thin coloring layer selectively.
[0096] As mentioned above, in this invention, the case where a coloring layer changes thickness selectively and is formed is not eliminated. About especially a coloring layer, in the field which laps with optical opening and the flat-surface target of a reflecting layer, it is substantially thick, and it is desirable to form thinly substantially in the field which laps with the other reflecting layer and a flat-surface target.
[0097] The depth of shade of the coloring layers 1114r, 1114g, and 1114b constituted so that the depth of shade of the coloring layers 1115r, 1115g, and 1115b which lap with opening 1112a superficially

here in order to heighten the above-mentioned effectiveness more might be jutted out of the field which is high and laps with opening 1012a superficially over the field which laps superficially with a part of reflector may be made low.

[0098] (Example 8 of a configuration) The configuration of the example 8 of a configuration is typically shown in drawing 7 . In this example 8 of a configuration, although the coloring layers 1214r and 1214b are extensively formed on the reflecting layer 1212 in R pixels and B pixels, 1214g of coloring layers is formed so that it may lap with a part of reflecting layer 1212 in G pixels. 1214g of coloring layers is constituted by breadth and this so that it may lap with a part of reflective section 1212b, so that 1214g of coloring layers may jut out opening 1212a over the opening edge with a wrap extensively.

[0099] In this example 8 of a configuration, the numerical aperture (ratio of the area of opening 1212a to the whole surface product of a reflecting layer 1212) of a reflecting layer 1212 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of G pixels (ratio of the area of 1214g of coloring layers to the area of reflective section 1212b) is 40 - 80%.

[0100] the rate of coat area of the coloring layers [on R pixels and B pixels and as opposed to reflective section 1212b by constituting as mentioned above] 1214r and 1214b (the ratio of the area of the coloring layer which laps with the reflective section 1212 to the area of the reflective section 1212 --) That is, he is trying to raise lightness by securing saturation by making a reflective coloring ratio into 100%, and making low the rate of coat area of 1214g of coloring layers to reflective section 1212b in G pixels. It becomes possible to raise the brightness of a reflective display, without reducing the saturation of R and B not much substantially, if it does in this way.

[0101] (Example 9 of a configuration) The configuration of the example 9 of a configuration is typically shown in drawing 8 . In this example 9 of a configuration, coloring layer 1314b covered the reflecting layer 1312 top with B pixels extensively (100% of rates of coat area), and it has opening 1314ra to which coloring layer 1314r exposes a part of reflecting layer 1312 by R pixels. Furthermore, in G pixels, while 1314g of coloring layers laps with opening 1312a of a reflecting layer 1312 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1312b.

[0102] Moreover, in this example 9 of a configuration, the numerical aperture of a reflecting layer 1312 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of G pixels of the rate of coat area of R pixels is 40 - 80% 60 to 100%.

[0103] (Example 10 of a configuration) The configuration of the example 10 of a configuration is typically shown in drawing 9 . In this example 10 of a configuration, coloring layer 1414b covered the reflecting layer 1412 top with B pixels extensively (100% of rates of coat area), and it has opening 1414ra to which coloring layer 1414r exposes a part of reflecting layer 1412 by R pixels. Two opening 1414ra(s) are prepared in this example. Furthermore, in G pixels, while 1414g of coloring layers laps with opening 1412a of a reflecting layer 1412 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1412b.

[0104] Moreover, in this example 10 of a configuration, the numerical aperture of a reflecting layer 1412 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of G pixels of the rate of coat area of R pixels is 40 - 80% 60 to 100%.

[0105] (Example 11 of a configuration) The configuration of the example 11 of a configuration is typically shown in drawing 10 . In this example 11 of a configuration, it has opening 1514ba to which coloring layer 1514b exposes a part of reflecting layer 1512 by B pixels. Two opening 1514ba(s) are prepared in this example. Moreover, coloring layer 1514r is equipped with opening 1514ra which exposes a part of reflecting layer 1512 in R pixels. Two opening 1514ra(s) are prepared in this example. Furthermore, in G pixels, while 1514g of coloring layers laps with opening 1512a of a reflecting layer 1512 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1512b.

[0106] Moreover, in this example 11 of a configuration, the numerical aperture of a reflecting layer 1512 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 40 - 80% 60 to 100% 70 to 100%.

[0107] (Example 12 of a configuration) The configuration of the example 12 of a configuration is typically shown in drawing 11 . In this example 12 of a configuration, it has opening 1614ba to which coloring layer 1614b exposes a part of reflecting layer 1612 by B pixels. Two opening 1614ba(s) are prepared in this example. Moreover, coloring layer 1614r is equipped with opening 1614ra which exposes a part of reflecting layer 1612 in R pixels. Two opening 1614ra(s) are prepared in this example. Furthermore, in G pixels, while 1614g of coloring layers laps with opening 1612a of a reflecting layer 1612 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1612b.
[0108] Moreover, in this example 12 of a configuration, the numerical aperture of a reflecting layer 1612 is common to RGB each pixel, and is 30%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 30.2% 65.3% 65.3%.
[0109] (Example 13 of a configuration) The configuration of the example 13 of a configuration is typically shown in drawing 12 . In this example 13 of a configuration, it has opening 1714ba to which coloring layer 1714b exposes a part of reflecting layer 1712 by B pixels. Two opening 1714ba(s) are prepared in this example. Moreover, coloring layer 1714r is equipped with opening 1714ra which exposes a part of reflecting layer 1712 in R pixels. Two opening 1714ra(s) are prepared in this example. Furthermore, in G pixels, while 1714g of coloring layers laps with opening 1712a of a reflecting layer 1712 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1712b.
[0110] Moreover, in this example 13 of a configuration, the numerical aperture of a reflecting layer 1712 is common to RGB each pixel, and is 30%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 40.2% 75.4% 75.4%.
[0111] (Example 14 of a configuration) The configuration of the example 14 of a configuration is typically shown in drawing 13 . In this example 14 of a configuration, it has opening 1814ba to which coloring layer 1814b exposes a part of reflecting layer 1812 by B pixels. Two opening 1814ba(s) are prepared in this example. Moreover, coloring layer 1814r is equipped with opening 1814ra which exposes a part of reflecting layer 1812 in R pixels. Two opening 1814ra(s) are prepared in this example. Furthermore, in G pixels, while 1814g of coloring layers laps with opening 1812a of a reflecting layer 1812 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1812b.
[0112] Moreover, in this example 14 of a configuration, the numerical aperture of a reflecting layer 1812 is common to RGB each pixel, and is 50%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 47.7% 75.4% 75.4%.
[0113] (Example 15 of a configuration) The configuration of the example 15 of a configuration is typically shown in drawing 14 . In this example 15 of a configuration, the reflecting layer 1912 of each pixel is formed where reflective section 1912b of a left Uichi pair is separated, and opening 1912a is formed between them. Moreover, the coloring layers 1914b and 1914r have covered the reflecting layer 1912 with B pixels and R pixels extensively. Furthermore, in G pixels, while 1914g of coloring layers laps with opening 1912a of a reflecting layer 1912 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1912b. Namely, reflective section 1912b is in the condition of having exposed selectively by opening 1914ga prepared in 1914g of coloring layers.
[0114] Moreover, in this example 15 of a configuration, the numerical aperture of a reflecting layer 1912 is common to RGB each pixel, and is 70%. Moreover, the rate of coat area of G pixels of the rate of coat area of B pixels and R pixels is 50.0% 100%.
[0115] (Optical property) Next, the optical property of the above-mentioned example 8 of a configuration thru/or the example 11 of a configuration is shown in drawing 15 . Drawing 15 shows the color data of the transmitted light of the RGB pixel of each above-mentioned example of a configuration, and the reflected light on xy chromaticity diagram in the xyz color coordinate system of 1931CIE. Generally, as xy chromaticity diagram is shown in drawing 16 , the tint actually checked by looking within the limits of the hanging bell configuration which makes a borderline the tint (a hue and

saturation) of the single wavelength light of a light field is arranged. Moreover, when performing color display using the coloring layer of three colors (for example, RGB), it is possible to form the tint in 3 square shapes formed by connecting the data point of each coloring layer RGB. The grace of color display will improve, so that the area of the three above-mentioned square shape is fundamentally large.

[0116] In drawing 15 , the color data (data point surrounded with the graphic display alternate long and short dash line) of a transparency display of the above-mentioned example 8-11 of a configuration and the color data (data point surrounded with the graphic display two-dot chain line) of a reflective display are written together. Here, as for a rhombus, x mark shows the data point whose triangle of a square is [data point / of example of configuration 8] the example 11 of a configuration about the data point of the example 10 of a configuration in the data point of the example 9 of a configuration. Moreover, graphic display H shows the data point of a white display.

[0117] The transparency section coloring layer which makes the numerical aperture of a reflecting layer 30%, and laps with opening to RGB each color in drawing 15 , respectively in order to compare with the color data of the above-mentioned example of a configuration, It measures also about the case where the light filter substrate which formed independently the reflective section coloring layer which laps with the reflective section, and was formed in the six-step process which performs six patterning is used, and the graphic display sunspot has shown as an example of a comparison. Here, the spectral transmittance of the above-mentioned transparency section coloring layer is shown in drawing 17 (a), and the spectral transmittance of the above-mentioned reflective section coloring layer is shown in drawing 17 (b). In order that light may go in a reflective field (reflective section), in order to penetrate a reflective section coloring layer twice to light penetrating a transparency section coloring layer once in a transparency field (opening), The transparency section coloring layer adopted what shows an optical property with comparatively high saturation (an average transmission coefficient T is low), as shown in drawing 17 (a), and although a reflective section coloring layer has comparatively low saturation as shown in drawing 17 (b), the average transmission coefficient T has adopted what shows a high optical property. Thereby, the brightness of a reflective display can be improved, securing the saturation of a transparency display.

[0118] In the examples 8-11 of a configuration concerning this invention, the coloring layer which presents the spectral transmittance shown in the same optical property as the transparency section coloring layer of the example of a comparison of the above-mentioned six-step process, i.e., drawing 17 , (a) was used. Consequently, as shown in drawing 15 , the color grace of the reflective display near the above-mentioned example of a comparison was able to be acquired. Especially the example 11 of a configuration has the composition of having a hue and saturation substantial almost equal to the above-mentioned example of a comparison. Thus, in this invention, color grace equivalent to the case where the optical property of the filter parts of a transparency field and a reflective field is set up independently is realizable. And since every two patterning (for example, photolithography process) is not needed about RGB each color to the above-mentioned example of a comparison, respectively, it has the advantage that a manufacturing cost can be reduced substantially.

[0119] As shown in the above-mentioned examples 8-15 of a configuration, as for the area of opening of said reflecting layer, it is desirable to be identically constituted between said pixels equipped with said coloring layer of a different color. This is because the amount of incident light can be made equal in the pixel of each color by being identically constituted between the pixels equipped with the coloring layer of the color from which the area of opening of a reflecting layer differs, so it becomes possible to perform color adjustment of a transparency display comparatively simply. For example, since the opening area which constitutes a transparency field is the same to mutual in RGB each color, since the manifestation mode of a color is the same as that of a transparency mold display, about the coloring layer of RGB each color, it can be suitably adjusted on the basis of the color material of the light filter used for a transparency mold display, and can set up the optical property of color material. Moreover, since it is identically constituted between the pixels equipped with the coloring layer of a color which is different also about the area of the reflective section, in case color adjustment of a reflective display is performed, it becomes easy to adjust the area on the reflective section of the coloring layer to each color.

For example, since the reflective aspect product which constitutes a reflective field is the same to mutual in RGB each color, since the manifestation mode of a color is the same as that of a reflective mold display, about the coloring layer of RGB each color, it can be suitably adjusted on the basis of the light filter used for a reflective mold display, and can set up the rate of coat area.

[0120] In the above-mentioned example of a configuration, the rates of coat area on said reflective section of said coloring layer differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that this may optimize the color of the transparency display realized by the transmitted light of opening, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.

[0121] When it has red, green, and the coloring layer of each blue color, brightness can be improved by making the rate of coat area of a green coloring layer smaller than the rate of coat area of red and a blue coloring layer, controlling lowering of the saturation in a reflective display. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field which laps with opening Since it is selectively influenced also in the reflected light reflected in the part of the coloring layer in the field which is mainly constituted by the light which penetrates a coloring layer twice in the field to which a reflective display laps with the reflective section, and laps with opening, while saturation generally becomes high rather than a transparency display in a reflective display, it is easy to become dark. Therefore, in a reflective display, as an optical property of a coloring layer, even if it reduces some saturation, it is necessary to raise lightness.

[0122] However, from especially relative luminous efficiency having a peak on the wavelength of 555nm, since red and a blue twist will also look brightly as for green or yellow even if it is the same amount of light energies, the relation between saturation and lightness differs for every color. For example, in order to make bright the coloring layer of red (R pixels) or blue (B pixels), unless the light energy of the wavelength region of red or blue is increased substantially, since there are neither an increase of light (light of green with high relative luminous efficiency or yellow), nor the sushi or approaches other than red or blue, when the whole quantity of light is restricted, they will cause lowering of the large saturation which does not deserve improvement in lightness. On the other hand, since it is hard to become dark even if it raises saturation, in [which makes a subject the wavelength region where relative luminous efficiency is high] being green (G pixels), even if it raises lightness, saturation does not fall substantially.

[0123] In the case of this invention, drawing requires coexistence of the saturation in a reflective display, and lightness by adjusting the rate of coat area on the reflective section of a coloring layer. In this case, in R pixels or B pixels, if the rate of coat area is reduced greatly, although it will become bright, since saturation falls rapidly, as for the rate of coat area, it is desirable to set up highly with 60 - 100%. Although the red except green and the light of a blue wavelength region will be contained in the reflected light by reducing the rate of coat area in G pixels on the other hand, since a big difference is in relative luminous efficiency to other wavelength regions of these, since saturation does not fall, it is so desirable [saturation] to set up low with 35 - 50% as a rate of coat area. The color repeatability and lightness of a reflective display can be raised securing the color repeatability of a transparency display by setting the green rate of coat area, red, and the blue rate of coat area as the above-mentioned range.

[0124] It has set for the above-mentioned example of a configuration, and the reflective section is arranged also for the gap in the perimeter enclosure of opening. That is, it is formed in the condition that opening was enclosed by the reflective section in the reflecting layer. Therefore, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated in opening. Since a coloring layer can be formed so that it may lap with a part for a center section and its perimeter of a reflecting layer by forming opening in the center of abbreviation of a reflecting layer especially, the production by which the optical-character ability of a light filter stopped being influenced easily, and was stabilized to the patterning error etc. is attained.

[0125] As for the numerical aperture to the reflecting layer by opening, it is desirable that it is 30 - 70%. Since a reflective display will generally become conversely dark although a transparency display becomes bright if the numerical aperture of a reflecting layer becomes large, it is necessary to set up the numerical aperture of a reflecting layer so that the balance of a transparency display and a reflective display may be taken. If a numerical aperture is too small, it is necessary to make the illuminance of a back light high, and, more specifically, the power consumption of a back light will increase. Moreover, if a numerical aperture is too large, a reflective display will become dark and it will be hard coming to check by looking. since the brightness of a reflective display can work by be establish the field which do not lap with a coloring layer in a part of reflective section with this operation gestalt , it become possible and take the balance of a transparency display and a reflective display in the above-mentioned range a numerical aperture be large in the range to the whole reflecting layer compared with the case adopt the structure piled up in the coloring layer can realize good color grace in the both sides of a transparency display and a reflective display . If a numerical aperture is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if a numerical aperture exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.

[0126] The operation gestalt in the case of using the electro-optic device containing the [operation gestalt of electronic equipment] above-mentioned liquid crystal panel as a display of electronic equipment is explained. Drawing 18 is the outline block diagram showing this whole operation gestalt configuration. The electronic equipment shown here has the same liquid crystal panel 200 as the above, and the control means 1200 which controls this. Here, a liquid crystal panel 200 is notionally divided into panel structure 200A and actuation circuit 200B which consists of semiconductor ICs etc., and it has drawn. Moreover, a control means 1200 has the source 1210 of a display information output, the display process circuit 1220, a power circuit 1230, and a timing generator 1240.

[0127] The source 1210 of a display information output is equipped with the memory which consists of a ROM (Read Only Memory), RAM (Random Access Memory), etc., the storage unit which consists of a magnetic-recording disk, an optical recording disk, etc., and the tuning circuit which carries out the alignment output of the digital picture signal, and based on various kinds of clock signals generated by the timing generator 1240, it is constituted so that display information may be supplied to the display information processing circuit 1220 in forms, such as a picture signal of a predetermined format.

[0128] The display information processing circuit 1220 performs processing of display information in which had various well-known circuits, such as a serial-parallel conversion circuit, magnification and an inverting circuit, a rotation circuit, a gamma correction circuit, and a clamping circuit, and it inputted, and supplies the image information to actuation circuit 200B with a clock signal CLK. Actuation circuit 200B includes a scanning-line actuation circuit, a data-line actuation circuit, and an inspection circuit. Moreover, a power circuit 1230 supplies a predetermined electrical potential difference to each above-mentioned component, respectively.

[0129] Drawing 19 shows the cellular phone which is 1 operation gestalt of the electronic equipment concerning this invention. The circuit board 2001 is arranged inside the case object 2010, and, as for this cellular phone 2000, the above-mentioned liquid crystal panel 200 is mounted to this circuit board 2001. A manual operation button 2020 is arranged and the antenna 2030 is attached in the front face of the case object 2010 free [frequent appearance] from the end section. A loudspeaker is arranged inside the receiver section 2040 and the microphone is built in the interior of the transmission section 2050.

[0130] The liquid crystal panel 200 installed in the case object 2010 is constituted so that the screen (the above-mentioned liquid crystal display field A) can be checked by looking through a display window 2060.

[0131] In addition, as for the electro-optic device and electronic equipment of this invention, it is needless to say that modification can be variously added within limits which are not limited only to the above-mentioned example of a graphic display, and do not deviate from the summary of this invention.

For example, although the liquid crystal panel shown in each above-mentioned operation gestalt is equipped with the structure of a passive-matrix mold, it is applicable also to the liquid crystal equipment of an active matrix using active components (active element), such as TFT (thin film transistor) and TFD (thin-film diode). Moreover, although the liquid crystal panel of the above-mentioned operation gestalt has the so-called COG type of structure, it may be constituted so that a flexible wiring substrate and a TAB substrate may be connected to the liquid crystal panel which is not the structure of mounting IC chip directly, for example, a liquid crystal panel.

[0132] Although the operation gestalt mentioned above explained the case where it applied to liquid crystal equipment, as an electro-optic device this invention is limited to this -- not having -- electroluminescence equipment -- especially Organic electroluminescence equipment, inorganic electroluminescence equipment, etc., Plasma display equipment, FED (field emission display) equipment, It is applicable to various kinds of electro-optic devices, such as equipment using the small television and digital micro mirror device (DMD) using an LED (light emitting diode) indicating equipment, an electrophoresis indicating equipment, the thin Braun tube, a liquid crystal shutter, etc.

[0133]

[Effect of the Invention] As mentioned above, as explained, according to this invention, the saturation of a transparency mold display can be improved, securing the brightness of a reflective mold display. Moreover, the difference in the color between the transparency mold displays with a reflective mold display can be reduced.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CORRECTION OR AMENDMENT

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G02F 1/1335
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[FI]

G02F 1/1335 520
G02F 1/1335 505
G02B 5/20 101

[Procedure amendment]
[Filing Date] April 13, Heisei 17 (2005. 4.13)
[Procedure amendment 1]
[Document to be Amended] Description
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The content of amendment]
[Claim(s)]
[Claim 1]
In the electro-optic device with which it has the electrooptic material layer arranged between the substrates of a couple, and comes to set up two or more pixels,
The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,
The field in which said reflecting layer arranged in each of said pixel is not prepared,
It is arranged and has two or more coloring layers which have two or more different colors so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared,
The reflective coloring ratio which is a ratio of the area of said reflective section, and the area of the field where said coloring layer in said reflective section is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The electro-optic device characterized by being the value from which the ratio of said reflective

coloring ratio and said transparency coloring ratio differed for every color.
[Claim 2]
In the electro-optic device with which it has the electrooptic material layer arranged between the substrates of a couple, and comes to set up two or more pixels,
The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,
The field in which said reflecting layer arranged in each of said pixel is not prepared,
It has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared,
The ratio of the area of said reflective section and the area of the field where said coloring layer in said reflective section is arranged is an electro-optic device characterized by being smaller than the ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged.
[Claim 3]
Said coloring layer is an electro-optic device according to claim 1 or 2 characterized by being arranged so that the field in which said reflecting layer is not prepared may be covered thoroughly.
[Claim 4]
Said coloring layer is an electro-optic device according to claim 1 to 3 characterized by being arranged so that it may ****** on said reflective section of the perimeter of a field in which said reflecting layer is not prepared from on the field in which said reflecting layer is not prepared.
[Claim 5]
The area of the field in which said each of said pixel reflecting layer is not prepared is an electro-optic device according to claim 1 to 4 characterized by being substantially the same mutually.
[Claim 6]
Said reflective section is an electro-optic device according to claim 1 to 5 characterized by being arranged in the perimeter enclosure of the field in which said reflecting layer is not prepared.
[Claim 7]
Said coloring layer is equipped with two or more kinds of coloring layers which have a different color,
The rate of coat area on said reflective section of said coloring layer is an electro-optic device according to claim 2 characterized by differing between said pixels equipped with said coloring layer of at least two different colors.
[Claim 8]
It is the electro-optic device according to claim 7 characterized by equipping said coloring layer with red, green, and the coloring layer of each blue color, and said rate of coat area of said green coloring layer being smaller than said rate of coat area of red and said blue coloring layer.
[Claim 9]
It is the electro-optic device according to claim 8 which said rate of coat area of said green coloring layer is 30 - 50%, and is characterized by said rate of coat area of red and said blue coloring layer being 60 - 100%.
[Claim 10]
The rate of the area of a field that said reflecting layer to the area of said reflective section is not prepared is an electro-optic device according to claim 1 to 9 characterized by being 30 - 70%.
[Claim 11]
Electronic equipment characterized by having an electro-optic device according to claim 1 to 10 and the control means which controls this electro-optic device.
[Claim 12]
The substrate with which two or more pixels were set up,
The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,
The field in which said reflecting layer arranged in each of said pixel is not prepared,
It is arranged and has two or more coloring layers which have two or more different colors so that it may

lap with said a part of reflective section and the field in which said reflecting layer is not prepared,
The reflective coloring ratio which is a ratio of the area of said reflective section, and the area of the field where said coloring layer in said reflective section is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The light filter substrate characterized by being the value from which the ratio of said reflective coloring ratio and said transparency coloring ratio differed for every color.
[Claim 13]
The substrate with which two or more pixels were set up,
The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,
The field in which said reflecting layer arranged in each of said pixel is not prepared,
It has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared,
The ratio of the area of said reflective section and the area of the field where said coloring layer in said reflective section is arranged is a light filter substrate characterized by being smaller than the ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged.
[Procedure amendment 2]
[Document to be Amended] Description
[Item(s) to be Amended] 0014
[Method of Amendment] Modification
[The content of amendment]
[0014]
In the electro-optic device with which the electro-optic device of this invention has the electrooptic material layer arranged between the substrates of a couple, and it comes to set up two or more pixels The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, It is arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared. The reflective coloring ratio which is a ratio with the area of the field where said coloring layer [in / it has two or more coloring layers which have two or more different colors, and / the area of said reflective section and said reflective section] is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The ratio of said reflective coloring ratio and said transparency coloring ratio is characterized by being a different value for every color.
[Procedure amendment 3]
[Document to be Amended] Description
[Item(s) to be Amended] 0015
[Method of Amendment] Modification
[The content of amendment]
[0015]
Such adjustment is a coloring layer, while according to this invention the coloring layer is arranged on the field in which the reflecting layer is not prepared and it becomes possible to adjust the brightness of the reflected light by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer.
Since it is unrelated to a lap condition with optical opening, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.
[Procedure amendment 4]
[Document to be Amended] Description

[Item(s) to be Amended] 0016
[Method of Amendment] Modification
[The content of amendment]
[0016]
Moreover, the electro-optic device of this invention has the electrooptic material layer arranged between the substrates of a couple, and sets it to the electro-optic device with which it comes to set up two or more pixels. The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, A ratio with the area of the field where said coloring layer [in / it has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared, and / the area of said reflective section and said reflective section] is arranged (it is only hereafter called a "reflective coloring ratio".) It is characterized by being smaller than the ratio (only henceforth a "transparency coloring ratio") of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once the brightness of the reflected light can be raised by making a reflective coloring ratio smaller than a transparency coloring ratio -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced.
[Procedure amendment 5]
[Document to be Amended] Description
[Item(s) to be Amended] 0017
[Method of Amendment] Modification
[The content of amendment]
[0017]
Moreover, as for said coloring layer, it is desirable to be arranged so that the field in which said reflecting layer is not prepared may be covered thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.
[Procedure amendment 6]
[Document to be Amended] Description
[Item(s) to be Amended] 0019
[Method of Amendment] Modification
[The content of amendment]
[0019]
Moreover, it becomes possible to form a coloring layer as a thing of one by being arranged so that said coloring layer may be jutted out on said reflective section of the perimeter of a field in which said reflecting layer is not prepared from on the field in which said reflecting layer is not prepared. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.
[Procedure amendment 7]
[Document to be Amended] Description
[Item(s) to be Amended] 0027
[Method of Amendment] Modification
[The content of amendment]
[0027]
Moreover, as for the area of the field in which said each of said pixel reflecting layer is not prepared, it is desirable that it is substantially the same mutually.
[Procedure amendment 8]
[Document to be Amended] Description

[Item(s) to be Amended] 0030
[Method of Amendment] Modification
[The content of amendment]
[0030]
In this invention, said coloring layer is equipped with two or more kinds of coloring layers which have a different color, and, as for the rate of coat area on said reflective section of said coloring layer (equivalent to the above-mentioned reflective coloring ratio), it is desirable to differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that the color of the transparency display realized by the transmitted light of the field in which the reflecting layer is not prepared by this may be optimized, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.
[Procedure amendment 9]
[Document to be Amended] Description
[Item(s) to be Amended] 0031
[Method of Amendment] Modification
[The content of amendment]
[0031]
In this invention, said coloring layer is equipped with red, green, and the coloring layer of each blue color, and, as for said rate of coat area of said green coloring layer, it is desirable that it is smaller than said rate of coat area of red and said blue coloring layer. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field in which the reflecting layer is not prepared, and the field with which it laps, a reflective display is mainly constituted by the light which penetrates a coloring layer twice in the field which laps with the reflective section, and is influenced by the reflected light by the coloring layer in the field in which the reflecting layer is not prepared selectively, and the field with which it laps. Therefore, generally, a reflective display tends to become dark, while saturation becomes high rather than a transparency display. By the way, even if relative luminous efficiency raises the saturation of a green light to an yellow-green wavelength field to becoming dark if the saturation of the light of red and blue goes up since it has a peak, it cannot become dark easily. Thereby, if it is going to raise lightness in a reflective display, it will become easy for especially the saturation of red or blue to fall. therefore, the pixel of red or blue -- setting -- the rate of coat area -- high -- carrying out (or [namely, / losing the area of the reflective section which does not lap with a coloring layer] -- or) It becomes possible to increase lightness substantially, securing [lessen, secure saturation, and] the color repeatability of a reflective display, if the amount of reflected lights is earned by what the rate of coat area is made low for in a green pixel (that is, the area of the reflective section which does not lap with a coloring layer is increased).
[Procedure amendment 10]
[Document to be Amended] Description
[Item(s) to be Amended] 0033
[Method of Amendment] Modification
[The content of amendment]
[0033]
As for said reflective section, in this invention, it is desirable to be arranged in the perimeter enclosure of the field in which said reflecting layer is not prepared. Since the field in which the reflecting layer is not prepared will be formed in the condition of having been enclosed by the reflective section, by this, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated to the field in which the reflecting layer is not prepared. As for especially the field in which said reflecting layer is not prepared, it is desirable to be formed in the center of abbreviation of the reflective section.
[Procedure amendment 11]

[Document to be Amended] Description
[Item(s) to be Amended] 0034
[Method of Amendment] Modification
[The content of amendment]
[0034]
As for the rate of the area of a field that said reflecting layer to the area of said reflective section is not prepared, in this invention, it is desirable that it is 30 - 70%. Since a reflective display will become conversely dark although a transparency display becomes bright if the rate of the area of a field that the reflecting layer to the area of the reflective section of a reflecting layer is not prepared generally becomes large, it is necessary to set up the rate of the area of a field that the reflecting layer to the area of the reflective section of a reflecting layer is not prepared so that the balance of a transparency display and a reflective display may be taken. If the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is more specifically too small, it is necessary to make the illuminance of a back light high, and the power consumption of a back light will increase. Moreover, if the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is too large, a reflective display will become dark and it will be hard coming to check by looking. Since the brightness of a reflective display can be earned by establishing the field which does not lap with a coloring layer in a part of reflective section with this operation gestalt It becomes possible to balance a transparency display and a reflective display compared with the case where the structure which put the coloring layer on the whole reflecting layer is adopted, in the above-mentioned range where the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is large. In the both sides of a transparency display and a reflective display, good color grace is realizable. If the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.
[Procedure amendment 12]
[Document to be Amended] Description
[Item(s) to be Amended] 0037
[Method of Amendment] Modification
[The content of amendment]
[0037]
Next, the substrate with which, as for the light filter substrate of this invention, two or more pixels were set up, The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, It is arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared. The reflective coloring ratio which is a ratio with the area of the field where said coloring layer [in / it has two or more coloring layers which have two or more different colors, and / the area of said reflective section and said reflective section] is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The ratio of said reflective coloring ratio and said transparency coloring ratio is characterized by being a different value for every color. Moreover, the substrate with which, as for the light filter substrate of this invention, two or more pixels were set up, The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, It has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared.

The ratio of the area of said reflective section and the area of the field where said coloring layer in said reflective section is arranged is characterized by being smaller than the ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged.
[Procedure amendment 13]
[Document to be Amended] Description
[Item(s) to be Amended] 0038
[Method of Amendment] Modification
[The content of amendment]
[0038]
By being arranged only in the part on the reflective section, while the coloring layer is arranged on the field in which the reflecting layer is not prepared according to this invention Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while becoming possible to adjust the brightness of the reflected light according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.
[Procedure amendment 14]
[Document to be Amended] Description
[Item(s) to be Amended] 0113
[Method of Amendment] Modification
[The content of amendment]
[0113]
(Example 15 of a configuration) The configuration of the example 15 of a configuration is typically shown in drawing 14. In this example 15 of a configuration, the reflecting layer 1912 of each pixel is formed where reflective section 1912b of a left Uichi pair is separated, and opening 1912a is formed between them. Moreover, the coloring layers 1914b and 1914r have covered the reflecting layer 1912 with B pixels and R pixels extensively. Furthermore, in G pixels, while 1914g of coloring layers laps with opening 1912a of a reflecting layer 1912 thoroughly, it was constituted so that it might ****** to the perimeter, and has lapped only with the part on reflective section 1912b. Namely, reflective section 1912b is in the condition of having exposed selectively by opening 1914a prepared in 1914g of coloring layers.

[Translation done.]

* NOTICES *

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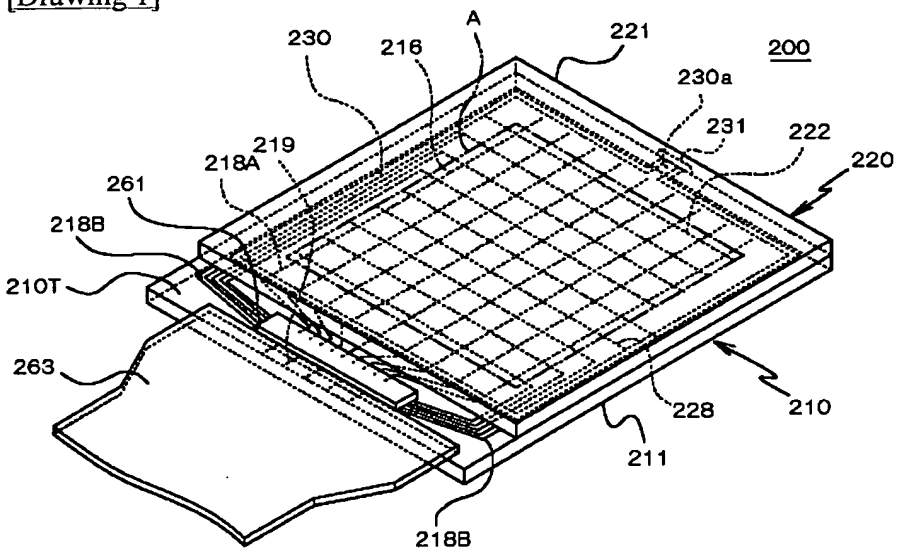
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



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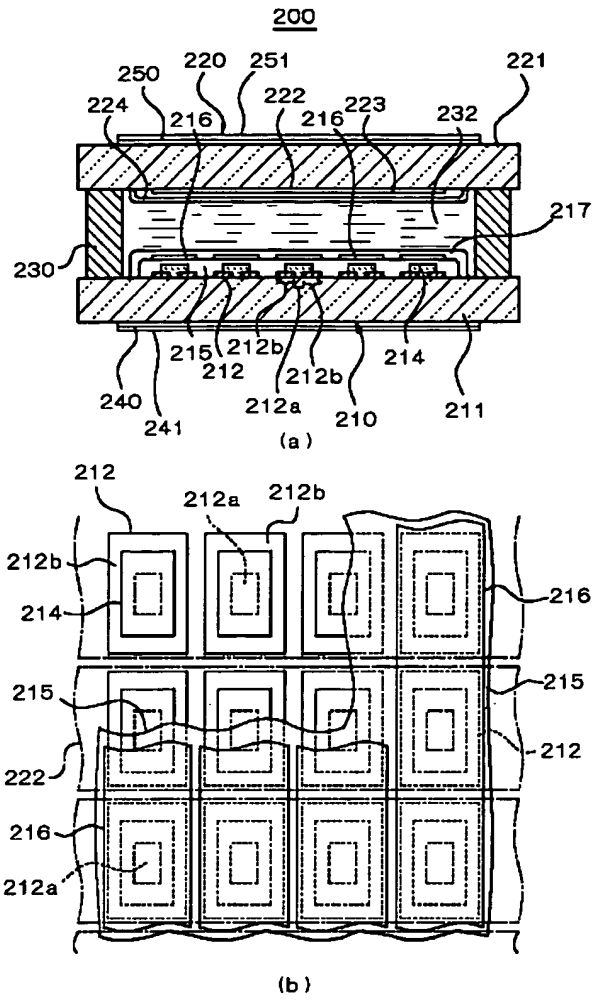
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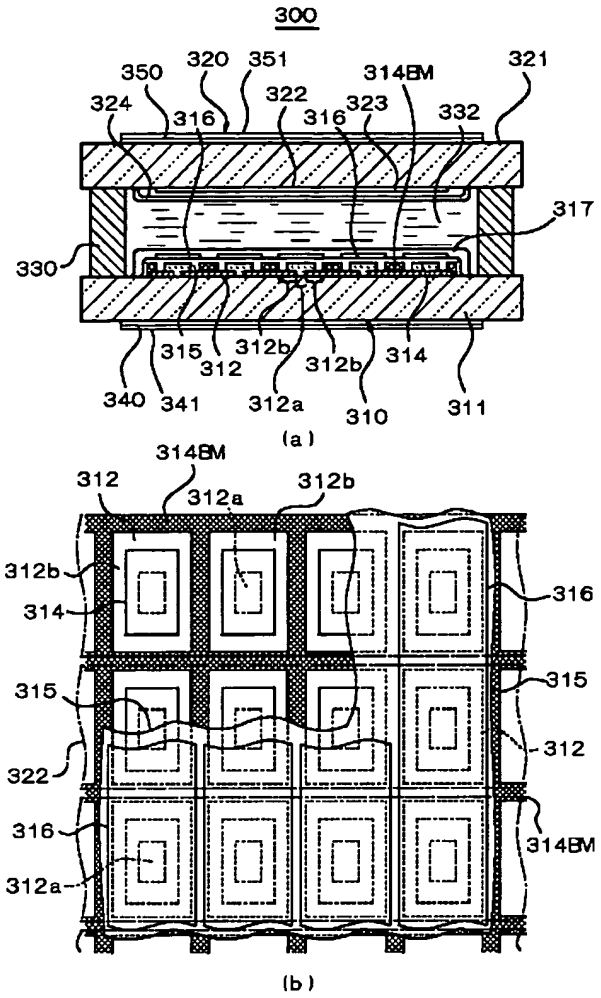
(b)

[Drawing 3]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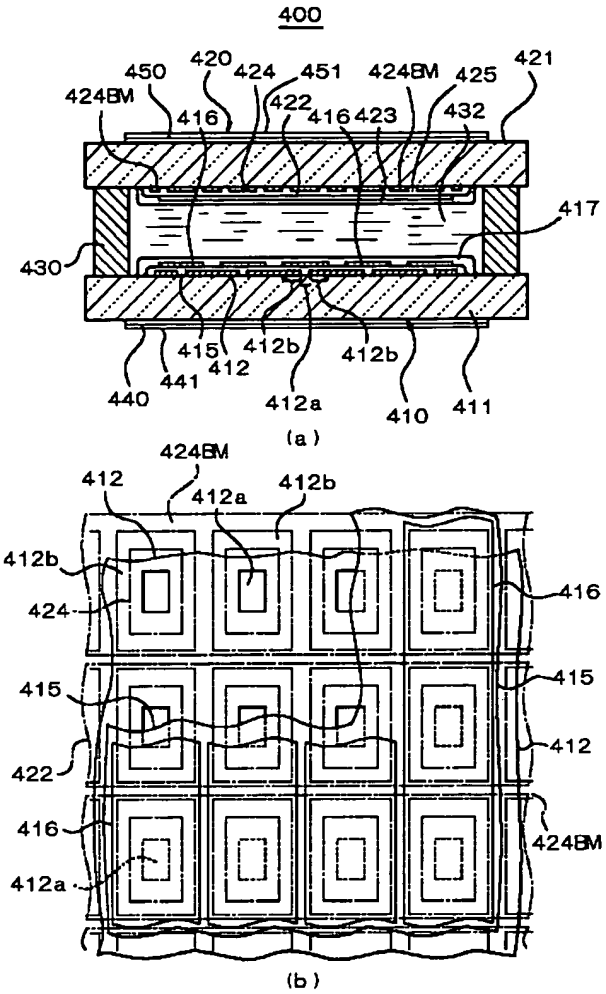
[Drawing 4]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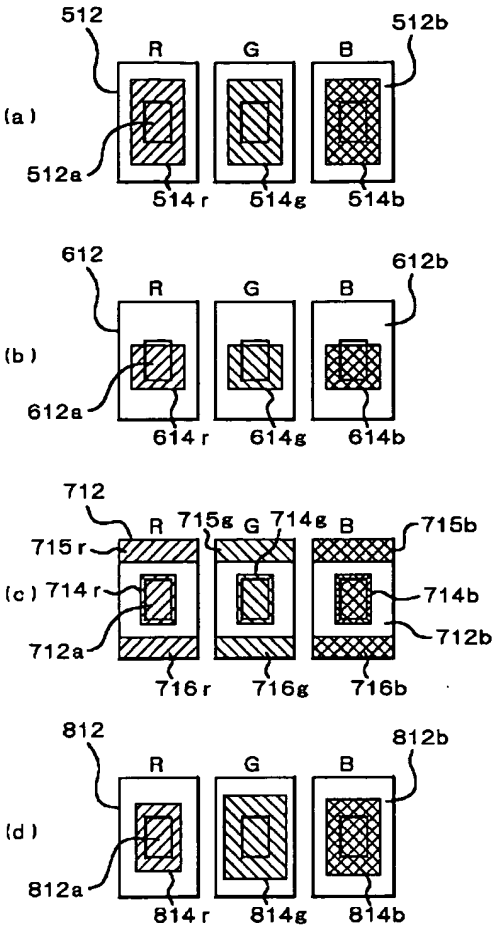
[Drawing 5]



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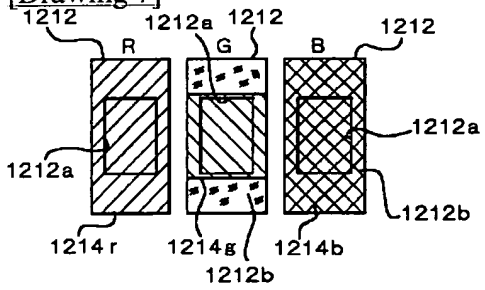

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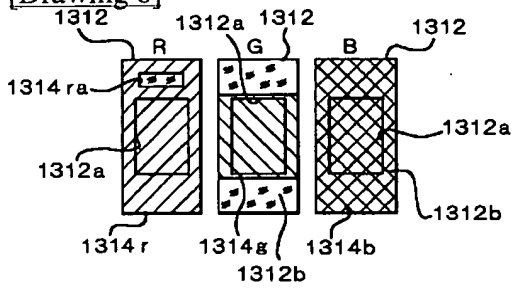

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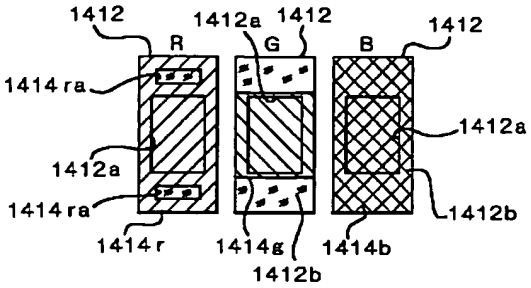

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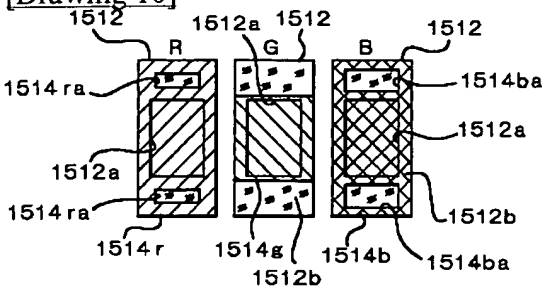

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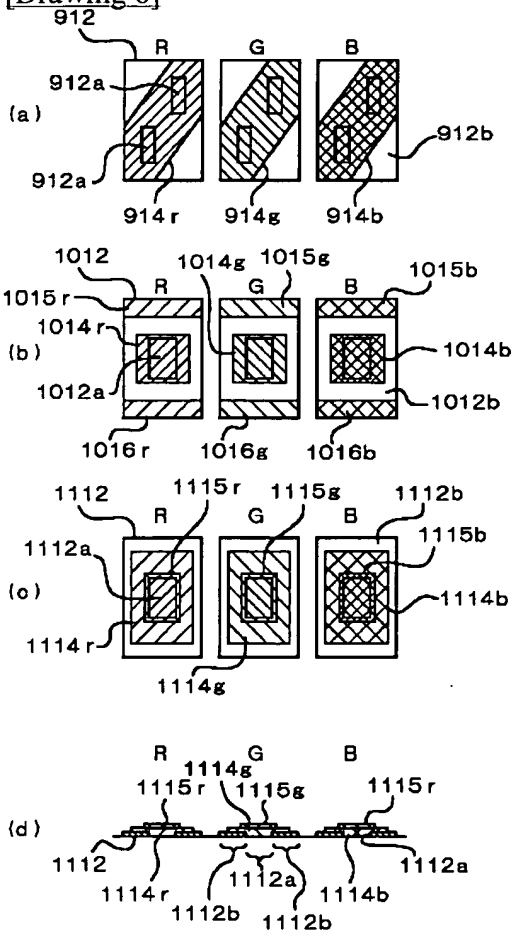

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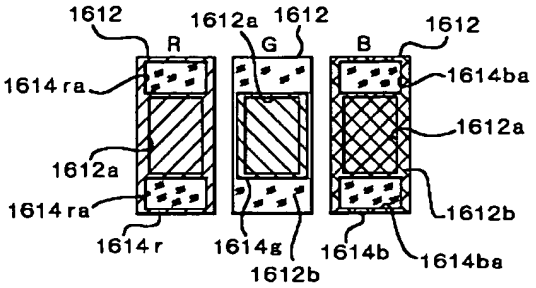

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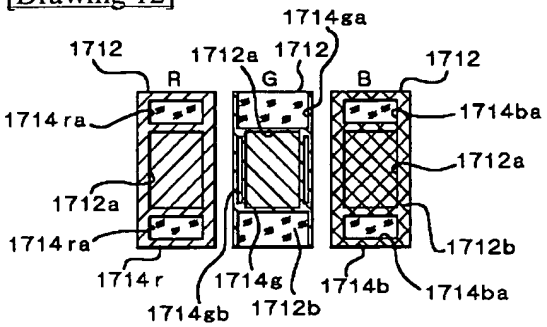

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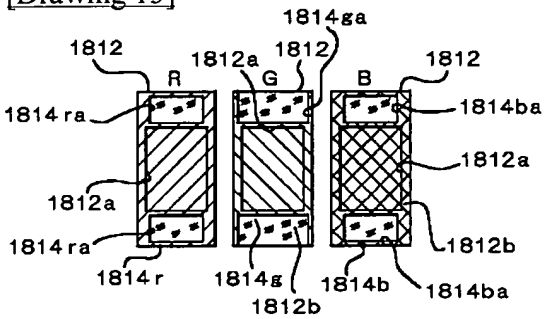
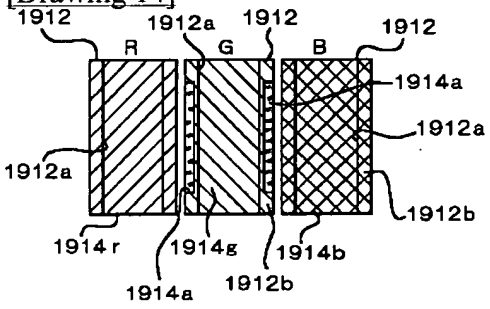
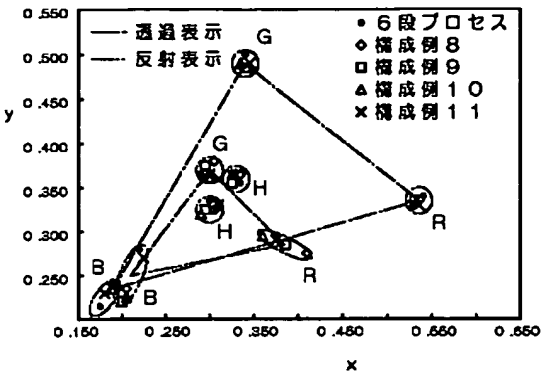


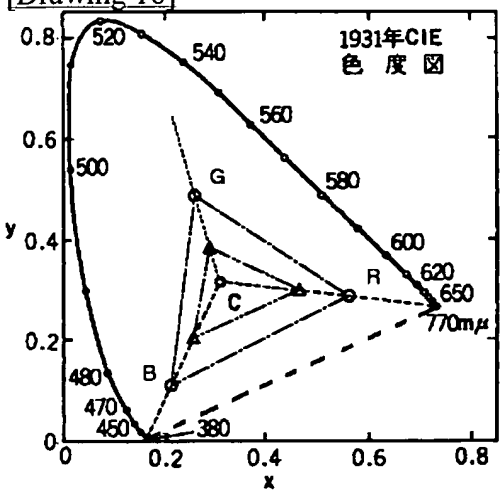
[Drawing 14]



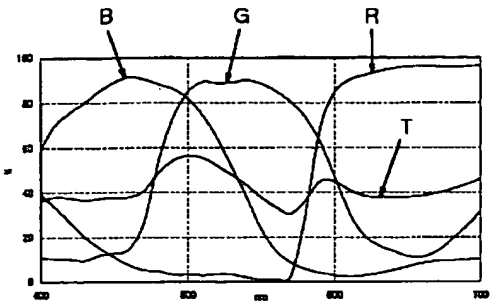
[Drawing 15]



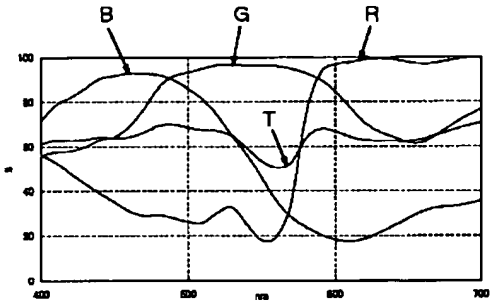
[Drawing 16]



[Drawing 17]

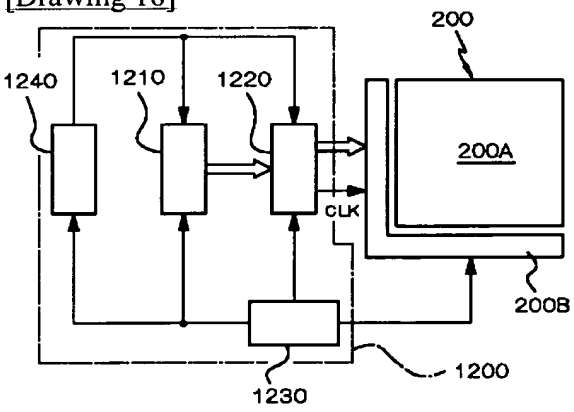


(a)

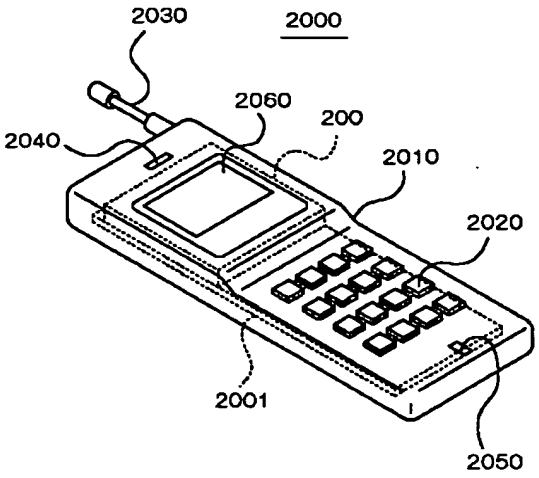


(b)

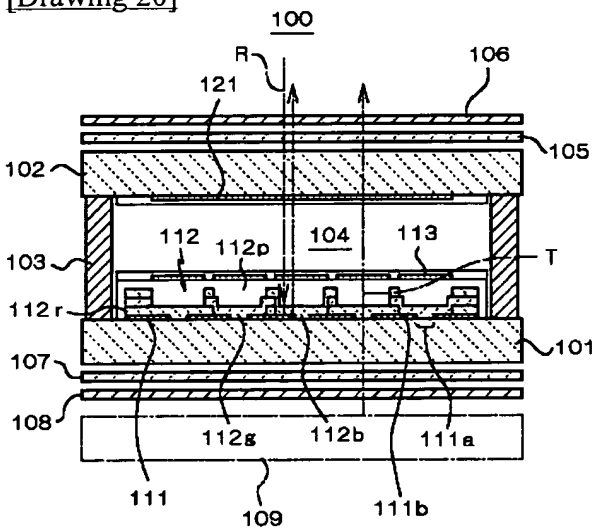
[Drawing 18]



[Drawing 19]



[Drawing 20]



[Translation done.]